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Computer Assisted Area Source Emissions Gridding Procedure (CAASE) User's Manual

Research Triangle Inst, Research Triangle Park, N C

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The National Air Data Branch of EPA has the responsibility for developing an accurate emissions inventory for all designated pollutants for the entire United States. The emissions inventory data must be in a format suitable for use as input to existing computer programs for displaying air quality, or for evaluating State Implementation Plans.

Point Sources of emissions present no difficulties with regard to the formatting of data for modeling. Area source emission data, however, present problems. Usually the smallest geographic unit for which accurate primary data are available is the county. These data must be disaggregated and appropriately allocated to smaller areas to provide an adequately detailed input.

The Computer Assisted Area Source Emissions gridding programs with associated subroutines and off-line procedures provide an objective method for allocating county-level data to grid squares selected on the basis of demographic features and sized to give appropriate detail for input to air quality modeling programs.

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The development of the CAASE system, and its application to fifteen (15) Air Quality Control Regions (AQCR's) thus far, has been largely a team effort with Dr. J. Hammerle and Mr. C. Masser of EPA/NADB contributing heavily to the development of the system.

The work has been conducted under the direction of Mr. Charles Masser, who is the EPA Project Officer for the contract.

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1.0 INTRODUCTION

1.1 Purpose

The National Air Data Branch of EPA has the responsibility for developing an accurate emissions inventory for all designated pollutants for the entire United States. The emissions inventory data must be in a format suitable for use as input to existing computer programs for displaying air quality, or for evaluating State Implementation Plans. Key computer programs which require emissions inventory data are the Air Quality Display Model (AQDM) and the Implementation Planning Program (IPP).

Point Sources of emissions present no difficulties with regard to the formatting of data for use with AQDM or IPP. Area source emission data, however, present problems. Usually, the smallest geographic unit for which accurate primary data (e.g. annual residential fuel consumption) are available is the county. These data must be disaggregated and appropriately allocated (as emissions) to smaller areas to provide an adequately detailed input for AQDM or IPP.

The CAASE programs (CAASE1 through CAASE5) with associated subroutines and off-line procedures provide an objective method for allocating county-level data to grid squares selected on the basis of demographic features and sized to give appropriate detail for input to air quality modeling programs. CAASE is an acronym made up of the first letters of Computer Assisted Area Source Emissions gridding.

1.2 General Background

The attainment of acceptable air quality within an Air Quality Control Region requires the implementation of appropriate strategies for the control of emissions of pollutants from individual sources or classes of sources. The probable success of candidate control strategies can be evaluated through the use of computer simulation models. These models manipulate the characteristics of the many sources, e.g. location, annual emissions, height and temperature of emissions, and meteorological conditions, e.g. wind direction and speed distribution with associated thermal stability conditions, to produce a distribution of ambient air pollutant concentrations over the region being considered.

Simulation models frequently used are based on Gaussian plume formations and accept as inputs either point sources, or area sources (which are converted to virtual point sources). Point sources are those individually identifiable boiler stacks, process vents, etc., emitting more than some arbitrarily specified mass of pollutant each year. Area sources, however, include the more ubiquitous, individually small sources which cannot be specifically located.

The objective of the CAASE method is the improvement of the characterization of area sources. Basic data for the determination of area source emissions seldom, if ever, are available for geographic or political units or areas smaller than the county, or in some cases, the large city which functions politically independently of the surrounding county. These basic data are in the form of, for example, annual fuel consumption, by fuel type, for residential, for commercial and institutional, and for industrial heating; acreage burned by forest fires; landing-takeoff cycles for military, for commercial and for civil aircraft; gasoline or diesel fuel consumed by light, heavy and off-highway vehicles, or vehicle miles traveled by road classification; etc. These data can be converted to pollutant emissions by the application of appropriate emission factors.

The geographic size of a county, however, is too large for practical use in simulation models for AQCR's. Logical procedures are required for distributing the county totals basic data or derived emissions data to smaller areas. Further constraints imposed by the simulation models require that these small areas be squares, although they need not be of uniform size. Various criteria have been proposed as bases for selecting the sizes and distribution of the emission area squares. Urbanization, land use, housing counts, and population have all been used subjectively to grid AQCR's into emission area squares (hereafter called grid squares) and subsequently to apportion county totals of pollutant emissions into each grid square. In general, the philosophy followed has required that urbanized or industrialized portions of the county or AQCR be gridded into small squares to provide for detailed representation of concentration of pollution sources. Conversely, rural areas with few pollution sources are adequately represented by large grid squares. Essentially, application of this philosophy results in apportioning county total emissions to grid squares according to subjective estimates of the distribution of population. Since air pollution derives from human activity this procedure provides a reasonable approach to developing area source emission distributions.

The development of the CAASE programs began as an effort to reduce the subjectivity inherent in distributing population into pre-selected grid squares. Success in this effort would concurrently reduce the time and effort required to complete the area source emission distribution.

The Bureau of the Census of the U.S. Department of Commerce has prepared a modified Master Enumeration District List (MEDList) which includes, in addition to the district identification, population count, housing count, etc., the geographic coordinates of the center of area of each of the enumeration districts. A computer plot of these population centers, coded to graphically represent population count used in conjunction with U.S. Geological Survey maps providing topographic and terrain features, furnishes a relatively detailed information base for constructing a county grid square system.

The procedures described in this manual have evolved from a feasibility study (Contract CPA 70-147) in which three AQCR's, 145 (Lancaster, Gage, and Jefferson Counties, Nebraska), 99 (South Central Kansas), and 130 (Metropolitan Fargo-Moorehead) were gridded. In this study the ambient air quality indicated by the AQDM simulation model, based on a previously prepared (by another EPA contractor) area source emissions grid and a corresponding simulation based on the CAASE grid were compared. Because smaller grid squares were used by the CAASE method for central urban areas — where the plotted population data showed concentrations of people — higher peak values of ambient pollutant concentrations were shown for the cities, and sharper gradients of pollutant concentrations appeared in the urban to rural transition zone. In rural areas ambient pollutant concentrations did not differ with the change in the grid system.

Subsequent to the demonstration of feasibility of the CAASE method, fifteen AQCR's have been gridded and area source emissions have been determined for each grid square (Contract 68-02-1014). From this experience, the CAASE method as described in this manual has evolved.

1.3 The CAASE Method

CAASE has five computer programs associated with it and various subroutines called by these programs. Off-line gridding is done in the procedure steps between the execution of the second and third programs. For convenience the programs have been numbered CAASE 1 through CAASE 5 and they perform the following functions:

CAASE1 strips the MED-X* census tape files for all of the enumeration district population entries for all counties in the Air Quality Control Region (AQCR) being processed. CAASE1 also converts the coordinates of the center of each enumeration district from latitude and longitude (in degrees) to Universal Transverse Mercator (UTM) coordinates which are used in dispersion modeling programs. CAASE1 also writes tape files to be used as input to the CAASE2 and the CAASE4 programs.

The CAASE2 program, using edited tape files written by CAASE1 and a line-drawing plotter (in this application a CALCOMP plotter), plots circles with their radii proportional to the population counts. A circle is plotted for each enumeration district with its center at the geographical center of the enumeration district. This plotted output can then be overlayed onto the standard USGS map(s). The maps and scaling used have been the USGS 1:250,000 with a 1-inch radius representing 4,000 people. CAASE2 plots a separate chart (map) for each county in the AQCR. This procedure is used because the primary purpose of the gridding is to select grid squares within a county so that total emissions (or total fuels) for the county can be apportioned into these grid squares. When all counties for a particular AQCR have been processed through CAASE1 and CAASE2, a grid for the entire AQCR must be determined using partly subjective means (see Section 8). In order to make this determination a light-table is used and the population plots are overlayed onto a USGS map(s) containing all counties for the AQCR. A grid is selected for the entire AQCR with each grid square having a side length which can range from 1 km to 30 km. Any size could be selected, but it is generally agreed that this is the range which will best depict the area source inputs for dispersion modeling, i.e. it provides enough resolution, but does not generate more resolution than the models warrant (which would result in a waste of computer time when dispersion modeling programs are run). Because determining the sizes of the grid squares and where they should be placed is partially subjective, the technical personnel performing this step should have had some experience in gridding area source emissions using other techniques or should have been trained to use this technique. That is to say, the CAASE1 and CAASE2 programs have simply produced, in graphical form, a representation of where the people are located within the counties.

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*Master Enumeration District Listing extended with geographic coordinates (MED-X).

After all grid squares have been constructed for the entire AQCR being processed, a card deck is prepared describing this grid for input to the CAASE3 program. Specifically, the grid squares are numbered in some orderly way, preferably sequentially by county. A load sheet is then prepared for keypunching a card associated with each grid square. On this load sheet the grid identification number (ID), the UTM coordinates of the lower left-hand corner of the grid square, and the side length of the square are entered. The county, state, and AQCR are also entered for identification purposes. It is very easy, during this step, to introduce clerical errors in the recording of coordinates and side lengths. However, the CAASE3 program offers an opportunity to find keypunch errors not discovered while verifying.

The CAASE3 program uses the input grid description cards and draws, to scale, a map of the entire AQCR. The map drawn by CAASE3 portrays the grid, and it is helpful in isolating any errors which may have been introduced when preparing the load sheets or in keypunching and verifying the cards. All grid elements must be square and errors of omission or the incorrect recording of a coordinate(s) are quite obvious when this map is visually checked. A symbol, in this application an "X," is optionally plotted at the center of each grid square to help in the location of errors.

After the grid description cards have been corrected, if necessary, for any errors found by using the CAASE3 program, the next step in the procedure is to use the CAASE4 program which assigns apportioning values to each of the grid squares. For each area source emission category included on the area source input form (EPA (DUR) 219 3/72), an apportioning factor has been assigned using objective data when possible. Bureau of the Census MED-X data tapes contain a population count, a housing count, and a rural/urban classification for each enumeration district. Each grid description card includes the side length of the grid square from which the area is calculated. County totals for most of the area source emissions categories can be objectively apportioned using population, housing, area, or a combination of these three measurements. One obvious exception is the apportioning of emissions from aircraft operations which would require a knowledge of airport locations and, if more than one airport was located within a county, their relative operations activity.

The CAASE4 program logic has been written to permit the user to subjectively override any of the objective apportioning factors. The actual apportioning factor for each source category used within the program, is the product of a weighting factor and the assigned objective factor. This allows the user to override the programmed (or objective) apportioning factor within any particular county (or counties) if information to do so is available. The output of the CAASE4 program includes binary tape files which are used as input files to the CAASE5 program. CAASE4 output files contain, for each grid square and source category combination for each county, a number which can be used to apportion a fraction of the county total into each grid square within the county. Each county within the AQCR is processed separately through the CAASE4 program using the grid squares associated with the county, the MED-X census data and any overriding weighting factors provided as additional input data.

The CAASE5 program, using "fuel" totals for each of the emission source categories for area sources, apportions these "fuels" into the individual grid squares. CAASE5 uses the same methods as those used in the EPA program NEO3 to calculate the emissions using fuel totals and emission factors for each of the source emissions categories. The term "SMEAR" has generally been used when describing the process of apportioning the total emissions for a county into the grid squares within a county. The CAASE5 program does the "SMEARING" by using apportioning factors assigned by CAASE4. CAASE5 first "SMEARS" the "fuel" for each of the categories into each of the grid squares and outputs (prints) a tabular listing (and writes a binary magnetic tape) for all grid squares within the county for each emissions source category. For each area source emissions category, each grid square receives a fraction of the county total — that fraction being the number associated with that particular grid square and "fuel" category divided by the sum of all apportioning numbers for that "fuel" category within the county. For any area source category, the apportioning fractions summed over all grid squares for that county equals unity.

Procedurely, the pollutant emissions are calculated for the county totals and then "SMEARED." This procedure is used, rather than calculating emissions for each grid square using "SMEARED" fuels, because the calculations for "SMEARING" do not require as much computer time as the calculations of the emissions. For each source category, emissions are calculated for the five pollutants: suspended particles (SP), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), hydrocarbons (HC), and carbon monoxide (CO). As emissions of each pollutant are calculated and "SMEARED," a tabular listing is output (printed) of the "SMEARED" emissions for each pollutant as was done with the fuels. The county totals for each emissions source category are output to indicate the contribution of each of them to the total emissions for each pollutant. For each grid square the "SMEARED" emissions from all source categories are summed for each pollutant for output in the Implementation Planning Program (IPP) expanded card format for area source inputs. A binary magnetic tape is also written containing all data items in the tabular listings and card decks. The output from CAASE5, then, includes tables of "SMEARED" fuel totals and "SMEARED" emissions for each of the five pollutants of interest, where for each grid square a separate value is printed for each source category. Also, a card deck is punched in the IPP format, containing, for each grid square, the total suspended particles, sulfur dioxide, oxides of nitrogen, hydrocarbon, and carbon monoxide emissions "SMEARED" into each grid square for all source categories. At the request of EPA the IPP input card format was expanded to include all five pollutants and the state and county code numbers. The county totals for each of the five pollutants are also printed and were used during the development and application of the CAASE method to compare CAASE program outputs with the total emissions for each county which were calculated by the EPA program NE03. A detailed description of each of these five main CAASE programs, their subroutines, the off-line gridding procedure, and the use of overriding apportioning factors, are contained in other sections of this manual.

Figure 1 is a flow chart of the overall CAASE system.

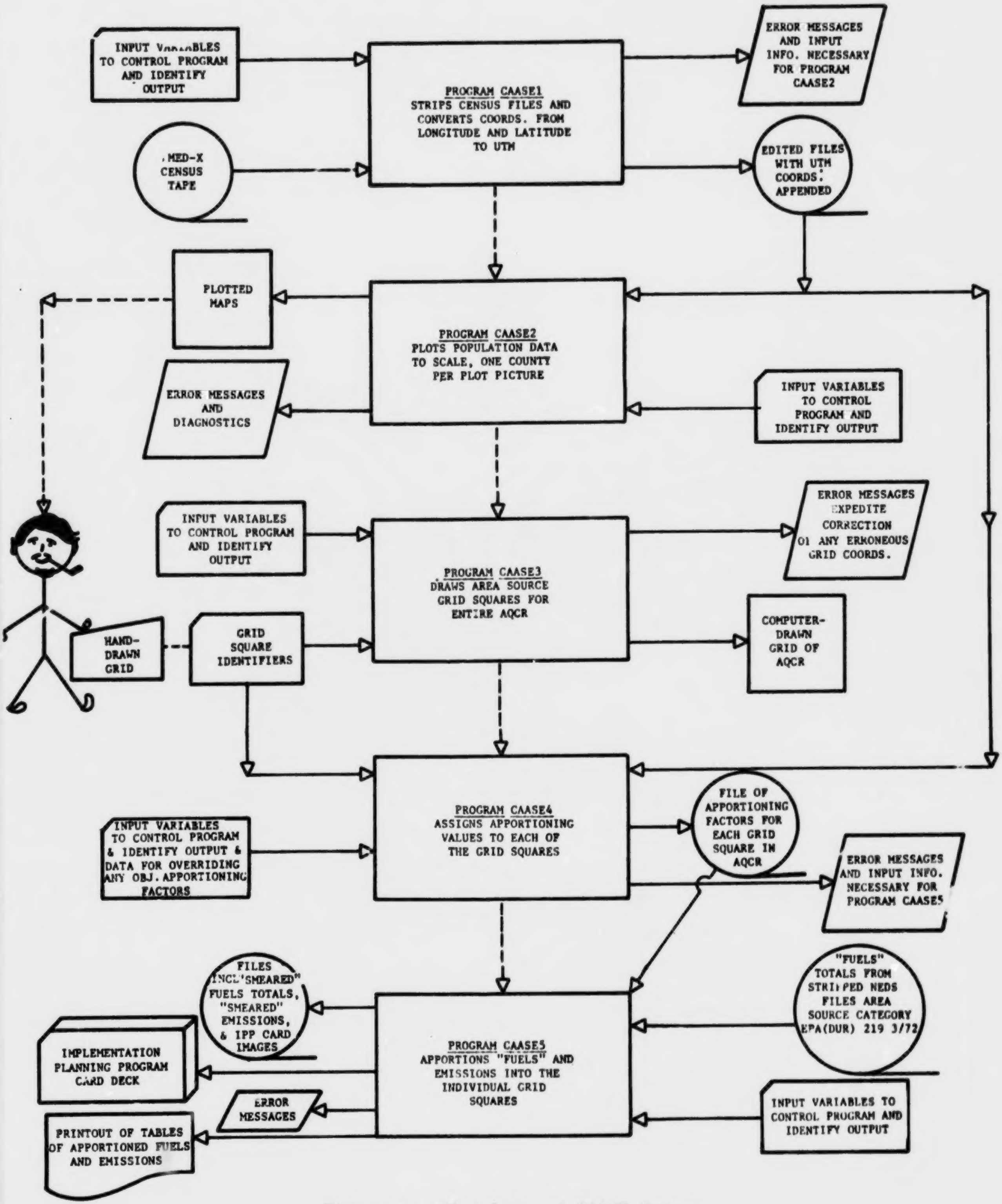
INPUT VARIABLES TO CONTROL PROGRAM AND IDENTIFY OUTPUT
PROGRAM CAASE1 STRIPS CENSUS FILES AND CONVERTS COORDS. FROM LONGITUDE AND LATITUDE TO UTM
ERROR MESSAGES AND INPUT INFO. NECESSARY FOR PROGRAM CAASE2
MED-X CENSUS TAPE
EDITED FILES WITH UTM COORDS. APPENDED
PLOTTED MAPS
PROGRAM CAASE2 PLOTS POPULATION DATA TO SCALE, ONE COUNTY PER PLOT PICTURE
ERROR MESSAGES AND DIAGNOSTICS
INPUT VARIABLES TO CONTROL PROGRAM AND IDENTIFY OUTPUT
INPUT VARIABLES TO CONTROL PROGRAM AND IDENTIFY OUTPUT
PROGRAM CAASE3 DRAWS AREA SOURCE GRID SQUARES FOR ENTIRE AQCR
ERROR MESSAGES EXPEDITE CORRECTION OF ANY ERRONEOUS GRID COORDS.
HAND-DRAWN GRID
GRID SQUARE IDENTIFIERS
COMPUTER-DRAWN GRID OF AQCR
INPUT VARIABLES TO CONTROL PROGRAM & IDENTIFY OUTPUT & DATA FOR OVERRIDING ANY OBJ. APPORTIONING FACTORS
PROGRAM CAASE4 ASSIGNS APPORTIONING VALUES TO EACH OF THE GRID SQUARES
FILE OF APPORTIONING FACTORS FOR EACH GRID SQUARE IN AQCR
ERROR MESSAGES AND INPUT INFO. NECESSARY FOR PROGRAM CAASE5
FILES INCL "SMEARED" FUELS TOTALS, "SMEARED" EMISSIONS, & IPP CARD IMAGES
"FUELS" TOTALS FROM STRIPPED NEDS FILES AREA SOURCE CATEGORY EPA(DUR) 219 3/72
IMPLEMENTATION PLANNING PROGRAM CARD DECK
PROGRAM CAASE5 APPORTIONS "FUELS" AND EMISSIONS INTO THE INDIVIDUAL GRID SQUARES
ERROR MESSAGES
PRINTOUT OF TABLES OF APPORTIONED FUELS AND EMISSIONS
INPUT VARIABLES TO CONTROL PROGRAM AND IDENTIFY OUTPUT

Figure 1. Flowchart of CAASE System

2.0 CAASE1 PROGRAM

2.1 Program Description

This program performs several functions which include the editing, conversion of coordinates (from geographic latitude and longitude to the universal trausverse mercator (UTM) system), flags those counties which cross (straddle) two UTM zones, and calculates the length of the X and Y axes necessary for the subsequent plotting of the population at enumeration district centers. The program will process one or several counties contained in one or more states making up an Air Quality Control Region. Because the counties are dealt with in later programs as separate entities, CAASE1 generates a separate file for each county. The program uses two types of input data, (1) the Bureau of the Census MED-X data tape (MEDList with latitudinal and longitudinal coordinates added), and (2) punched cards to specify the values of variables for the county (or counties) being processed. Outputs include an edited, or stripped, file for each county, diagnostic messages, error messages when necessary, and information to aid in the execution of the next program in the series. In addition to systems subprograms, the subroutine CED009, described in Section 7.1 is used for converting coordinates. A logical flow chart describing CAASE1 is included in Appendix A.

2.2 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 2. Using the Parkersburg-Marietta AQCR as an example, the associated JCL and input data cards are illustrated in Figure 3. The JCL cards illustrated assume the following:

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a. The program is in object deck form.

b. The punched cards assigning values to the variables are in the input job stream.

c. The MED-X census data are on magnetic tape.

d. The number of counties to be processed is nine and are located in two states (Ohio and West Virginia).

e. The output of census data is on magnetic tape with a separate file created for each county.

2.3 Input Information

A description of the punched card input variables appears in Table 1. It includes the scaling factor, the name of the selected Air Quality Control Region, the number of states in the AQCR, the name of each state, the number of counties in each state, the Federal county code number, and the name of each county. The scaling factor, which has the same value as one which will be used in the plotting of the population centers in CAASE2, is used with the differences between the minimum and maximum UTM coordinates of the easting and northing for UTM zone(s) associated with the county being processed to calculate the size of the plot "picture" needed. The scaling factor, although variable, has been calculated for a scale of 1:250,000 for all processing done in the applications thus far using the CAASE method. The input card layout is described in Table 2.

2.4 Output Information

Printed output from the program includes the Air Quality Control Region, state(s), and county(ies) being processed. Also output for each UTM zone in the county (most counties include only one zone), is the zone number, the minimum and maximum easting and northing UTM coordinate, and the minimum X axis and Y axis (in inches, using the scale factor (SCALEX) that was read in), necessary to portray all population centers on a computer drawn map. When all records for a county of interest have been processed, the county name, its number, and the number of records written on the output tape are printed. A magnetic tape is written with a separate file created for each county processed. Once the county of interest is found on the MED-X tape, a record is written for each input record except for the population data summary. The summarization of enumeration district population counts can be recognized by the program because the latitudinal and longitudinal coordinates are zero. Error messages are printed and, if they are fatal, the program operation is terminated. The census data record written by CAASE1 is essentially the same as the MED-X input record with the UTM zone number and the easting and northing UTM coordinates for each population center appended. Figure 4 is an example of a printout from CAASE1.

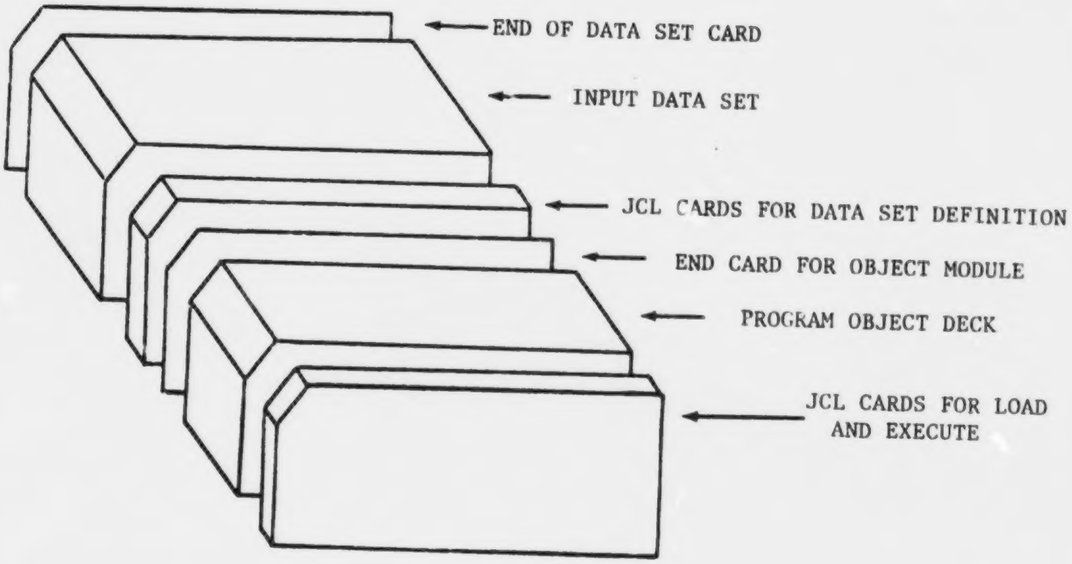
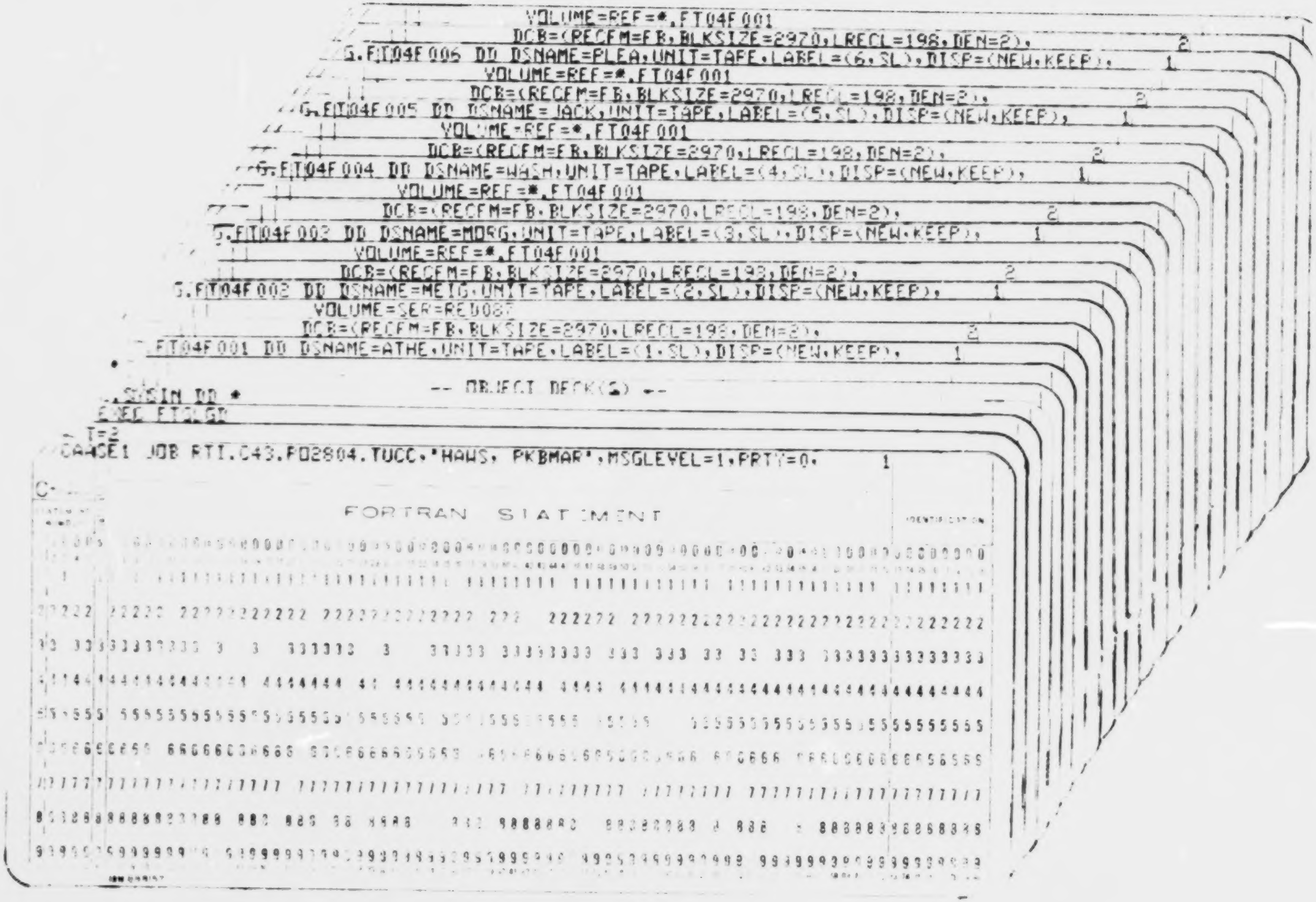
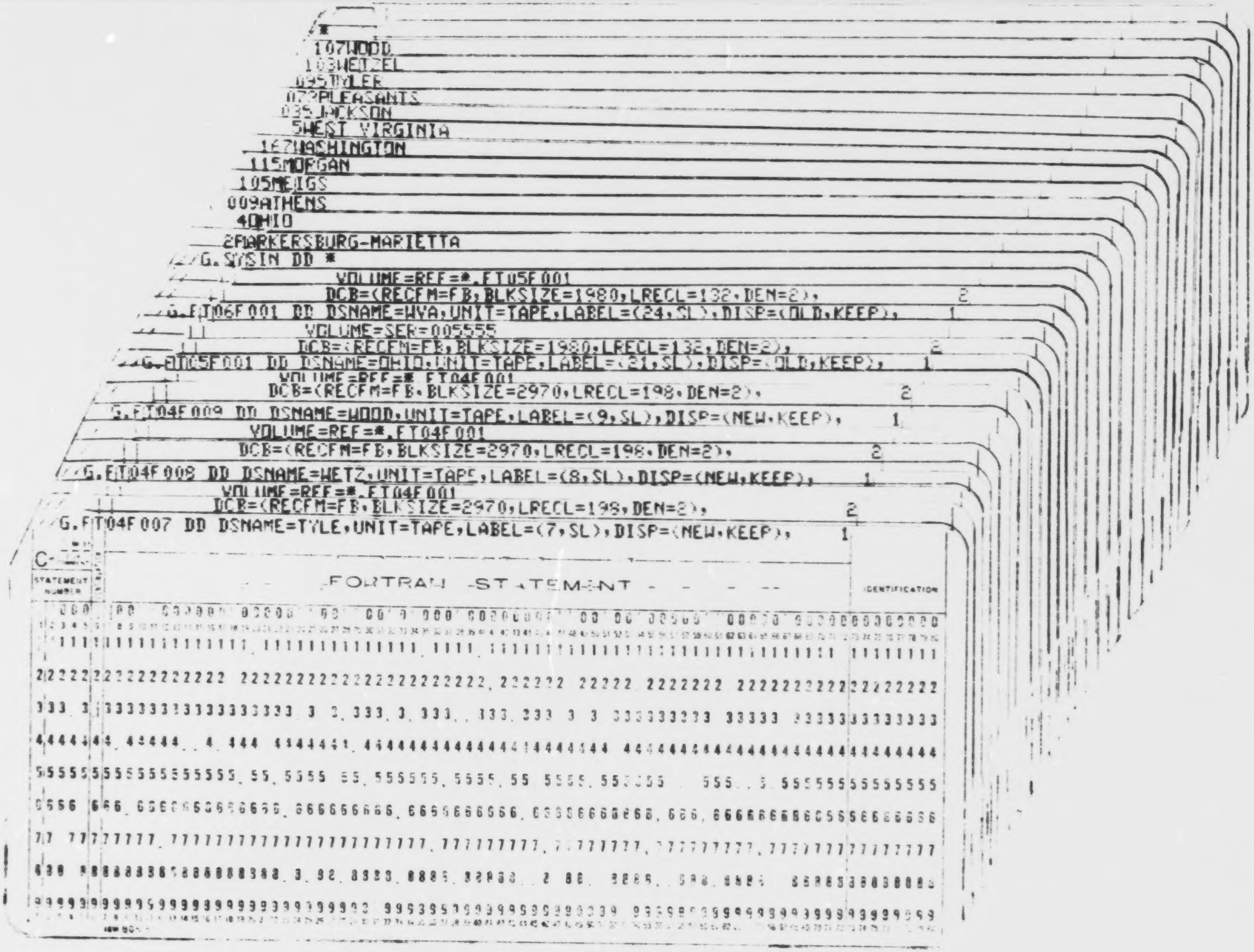

END OF DATA SET CARD
INPUT DATA SET
JCL CARDS FOR DATA SET DEFINITION
END CARD FOR OBJECT MODULE
PROGRAM OBJECT DECK
JCL CARDS FOR LOAD AND EXECUTE

Figure 2. Example of Deck Configuration for the CAASE Programs



```
VOLUME=REF=*.FT04F001
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
G.FT04F006 DD DSNAME=PLEA,UNIT=TAPE,LABEL=(6,SL),DISP=(NEW,KEEP),    1
VOLUME=REF=*.FT04F001
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
G.FT04F005 DD DSNAME=JACK,UNIT=TAPE,LABEL=(5,SL),DISP=(NEW,KEEP),    1
VOLUME=REF=*.FT04F001
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
G.FT04F004 DD DSNAME=WASH,UNIT=TAPE,LABEL=(4,SL),DISP=(NEW,KEEP),    1
VOLUME=REF=*.FT04F001
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
G.FT04F003 DD DSNAME=MORG,UNIT=TAPE,LABEL=(3,SL),DISP=(NEW,KEEP),    1
VOLUME=REF=*.FT04F001
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
G.FT04F002 DD DSNAME=MEIG,UNIT=TAPE,LABEL=(2,SL),DISP=(NEW,KEEP),    1
VOLUME=SER=RE0087
DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),                  2
.FT04F001 DD DSNAME=ATHE,UNIT=TAPE,LABEL=(1,SL),DISP=(NEW,KEEP),     1
                    -- OBJECT DECK(S) --
.SYSIN DD *
EXEC FTGLGO
I=2
CAASE1 JOB RTI.C43.F02804.TUCC,'HAWS, PKBMAR',MSGLEVEL=1,PRTY=0,     1
```

Figure 3. JCL and Input Data Cards for CAASE1



```
/*
107WOOD
103WETZEL
095TYLER
073PLEASANTS
035JACKSON
5WEST VIRGINIA
167WASHINGTON
115MORGAN
105MEIGS
009ATHENS
4OHIO
2PARKERSBURG-MARIETTA
//G.SYSIN DD *
//             VOLUME=REF=*.FT05F001
//             DCB=(RECFM=FB,BLKSIZE=1980,LRECL=132,DEN=2),             2
//G.FT06F001 DD DSNAME=WVA,UNIT=TAPE,LABEL=(24,SL),DISP=(OLD,KEEP),     1
//             VOLUME=SER=005555
//             DCB=(RECFM=FB,BLKSIZE=1980,LRECL=132,DEN=2),             2
//G.FT05F001 DD DSNAME=OHIO,UNIT=TAPE,LABEL=(21,SL),DISP=(OLD,KEEP),    1
//             VOLUME=REF=*.FT04F001
//             DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),             2
//G.FT04F009 DD DSNAME=WOOD,UNIT=TAPE,LABEL=(9,SL),DISP=(NEW,KEEP),     1
//             VOLUME=REF=*.FT04F001
//             DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),             2
//G.FT04F008 DD DSNAME=WETZ,UNIT=TAPE,LABEL=(8,SL),DISP=(NEW,KEEP),     1
//             VOLUME=REF=*.FT04F001
//             DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),             2
//G.FT04F007 DD DSNAME=TYLE,UNIT=TAPE,LABEL=(7,SL),DISP=(NEW,KEEP),     1
```

Figure 3. (Continued)

TABLE 1. TABLE OF INPUT VARIABLES, CAASE1

VARIABLE NAME	DEFINITION
SCALEX	Scaling factor used to convert the distance in kilometers to plotter inches.
NSTAT	Number of states in AQCR
AQCR	Name of selected Air Quality Control Region
NCNTY	Number of counties in state
STATE	Name of selected state
ICNTY	Federal county code number for selected county
CNTY	Name of selected county

TABLE 2. INPUT CARD LAYOUT, CAASE1

CARD TYPE	COLUMNS	FORMAT	VARIABLE NAME
1	1-12	F12.0	SCALEX
2	1-4	I4	NSTAT
	5-24	5A4	AQCR
3[*]	1-4	I4	NCNTY
	5-24	5A4	STATE
4[†]	1-4	I4	ICNTY
	5-24	5A4	CNTY

---

[*] CARD TYPE 3 is repeated after the set of CARD 4's if the AQCR contains more than one state, and is followed by the necessary CARD 4's.

[†] CARD TYPE 4 is repeated depending on the number of counties in the state.

```
AIR QUALITY CONTROL REGION IS PARKERSBURG-MARIETTA
    NO. OF STATE(S) INCLUDED IS    2

    THE STATE OF OHIO              HAS    4 COUNTY(S)

   COUNTY WASHINGTON

 393116716710052310402          131141080301LOWELL                                     0011 1   10    293.     852.
     0.8150980000000000D 02   0.3953520000000000D 02   17           456.19           4376.08

 39311671671005    7            131141080301REMAINDER OF MCD (OR CCD)                  0012 1   10    366.    1051.
     0.8152770000000000D 02   0.3954280000000000D 02   17           454.66           4376.94

 393116716710102390401          131141080301MACKSBURG                                  0009 1   10    103.     266.
     0.8146250000000000D 02   0.3963320000000000D 02   17           460.31           4386.94

 393116716710200355407        6020131141080301BELPRE                               0201   0056 0   10    800.    2635.
     0.8158180000000000D 02   0.3929520000000000D 02   17           449.83           4349.48

    FOR COUNTY WASHINGTON        XMIN,YMIN=       430.93          4348.92       XMAX,YMAX=           494.51        4386.94
   MINIMUM X-AXIS=          10.01 IN.   MINIMUM Y-AXIS-           5.99IN.

      COUNTY NAME                 CODE NO.          NO. OF RECORDS WRITTEN ON TAPE

       ATHENS                        9               55

       MEIGS                       105               28

       MORGAN                      115               21

       WASHINGTON                  167               64

    THE STATE OF WEST VIRGINIA       HAS    5 COUNTY(S)

      COUNTY NAME                 CODE NO.          NO. OF RECORDS WRITTEN ON TAPE

       JACKSON                      35               24

       PLEASANTS                    73               12

       TYLER                        95               15

       WETZEL                      103              131


  GOOD FINISH
```

Figure 4. Example of a Printout from CAASE1

3.0 CAASE2 PROGRAM

3.1 Program Description

The purpose of this program in the CAASE system is to graphically portray the population centers within the county, both as to location and to number of people in each of the enumeration districts. The program is also used to resolve the problem presented when an Air Quality Control Region straddles a UTM zone boundary. Because the gridding of an AQCR requires a common reference point, when more than one UTM zone lies within the AQCR, one of the zones must be declared the primary zone. The primary zone may be either the westernmost or the easternmost of the two; an input variable is used to indicate which. In most applications thus far, when an AQCR straddled a zone boundary, the western zone has been declared the primary zone and the points falling in the eastern zone have been converted using the subroutine GTGR obtained from EPA. In some cases, to declare the eastern zone the primary zone could yield negative easting coordinates which, at the time of this application, were unacceptable to the Implementation Planning Program (IPP).

Several counties may be processed during a single computer run with this program but the processing is done in series with a separate plotter output picture (map) for each county. A standard picture size of 10.5 inches for the south to north axis and 14.0 inches for the west to east axis usually will be sufficient for plotting a county using a map scale of 1:250,000. Provisions are made in the program to use overriding input variables to produce a picture with a south to north axis up to 29.5 inches. The west to east axis may be of any practical length because the plotter paper is on a continuous roll. When these overriding picture size options are used an "operator message" is issued to enable the operator to change paper on the plotter. Prudence would suggest not mixing standard size plots with "special case" (wide paper) plots. In addition to the subroutine GTGR, which converts coordinates from one UTM zone to another, CAASE2 uses the subroutine POPMAP which places a small triangle in the center of each enumeration district and draws a circle, with radius proportional to the

Preceding page blank

population, around the triangle. The subroutine POPMAP is described in Section 7.3. The CAASE2 program uses two types of input data, (1) the edited MED-X data tape output from CAASE1, and (2) punched cards to specify the values of variables including scaling factors, optional picture size, and labeling information for the county (or counties) being processed. Outputs include a plotted map depicting the location and population of each enumeration district in a county. This map is drawn to the scale of the map which will be used when selecting the grid for the AQCR being processed. Also output from this program are diagnostic messages, error messages when necessary, and a summary of records plotted for each county processed. A logical flow chart describing CAASE2 is included in Appendix B. Subroutine GTGR is described in Section 7.2.

3.2 Job Control Language (JCL) and Deck Setup

An example of the deck setup configuration is illustrated in Figure 2. The JCL cards associated with an example to plot Washington County, Ohio, in the Parkersburg-Marietta AQCR, are illustrated in Figure 5. The JCL configuration illustrated assumes the following:

a. The program is in object deck form.

b. The punched cards assigning values to the variables are in the job input stream.

c. The population data are on magnetic tape, and were output from CAASE1 on reel number RED087 as file number four.

d. The number of counties to be processed is one and can be plotted using the standard 10.5 inches by 14.0 inches plotting picture.

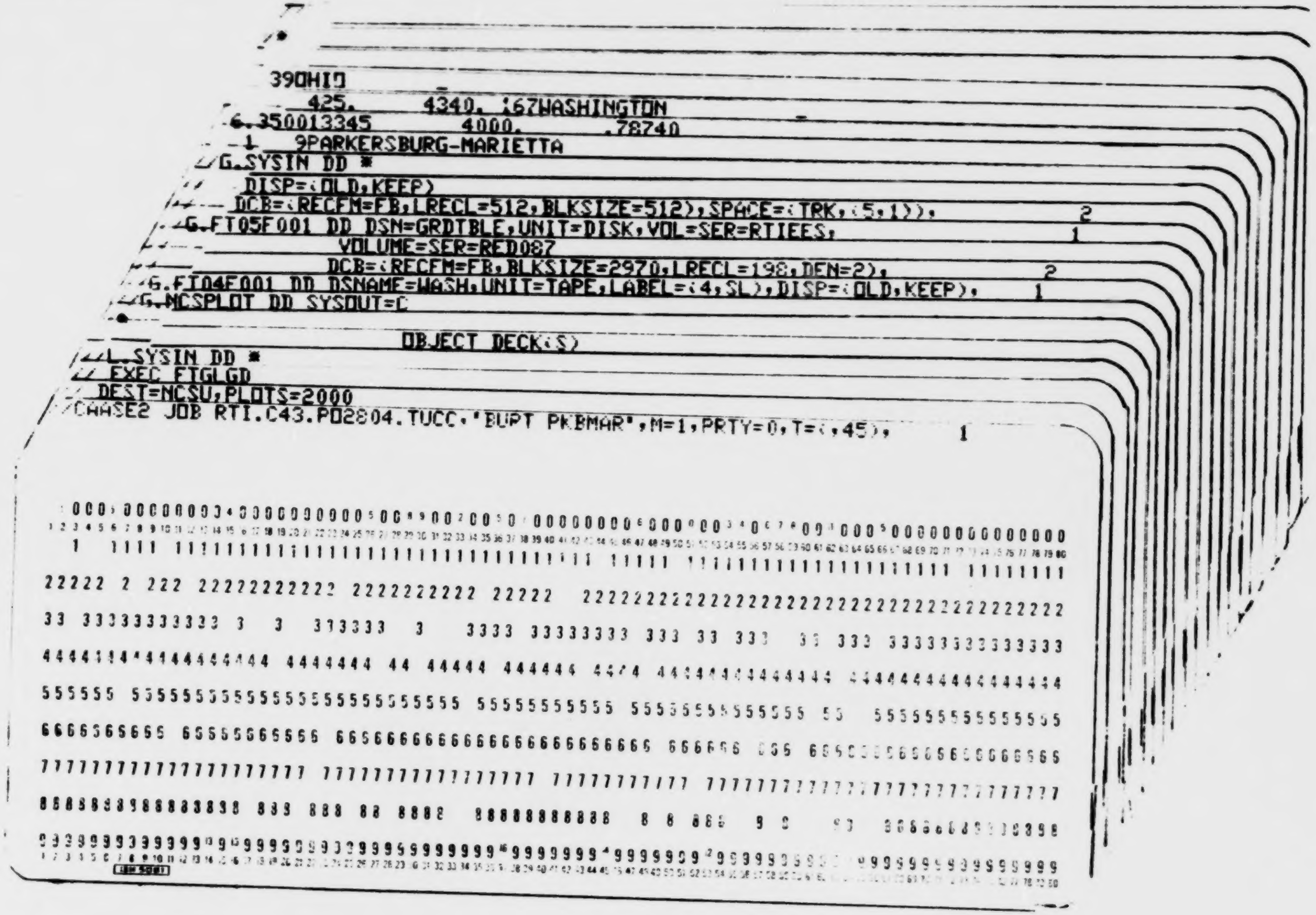
e. The tables used by the GTGR subroutine are on a disk (not needed for this AQCR, but JCL cards are included in the example).

3.3 Input Information

The punched card input variables appear in Table 3. They include the number of counties to be plotted for the AQCR during this computer run, the total number of counties in the AQCR, the AQCR name, the primary UTM zone, the east-west direction to convert coordinates to the primary zone when the AQCR straddles a UTM zone boundary, the scaling factors to convert population to the radius of a circle (in plotter space inches), and the spacing between axes tick-marks. Also input for each county to be plotted are cards containing the UTM coordinates for an appropriate origin, the county code, county name, state code and state name, and an axes flag to indicate whether the standard axes lengths will be used. For a county requiring longer axes than standard, input cards are necessary specifying the length (in inches of plotter space) of the X and Y axes and the number of tick-marks required. The input card layout is described in Table 4.

3.4 Output Information

Output from CAASE2 includes the printing of the AQCR name, total number of counties in the AQCR, and the number of counties plotted. Also output on the printer are the distance and population scaling factors, and any error messages returned from subroutines POPMAP and GTGR. At the end of the processing of all counties for any computer run, the county names, their numbers, and the number of records plotted for each county are also printed. See Figure 6 for an example of the printed output for Washington County, Ohio and Figure 7 for the plotter output.



```
/*
//*
390HIO
    425.       4340. ;67WASHINGTON
6.350013345       4000.       .78740
1    9PARKERSBURG-MARIETTA
//G.SYSIN DD *
//       DISP=(OLD,KEEP)
//       DCB=(RECFM=FB,LRECL=512,BLKSIZE=512),SPACE=(TRK,(5,1)),        2
//G.FT05F001 DD DSN=GRDTBLE,UNIT=DISK,VOL=SER=RTIEES,                   1
//              VOLUME=SER=RED087
//              DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),           2
//G.FT04F001 DD DSNAME=WASH,UNIT=TAPE,LABEL=(4,SL),DISP=(OLD,KEEP),     1
//G.NCSPLOT DD SYSOUT=C
.
                         OBJECT DECK(S)
//L.SYSIN DD *
// EXEC FTGLGD
// DEST=NCSU,PLOTS=2000
//CAASE2 JOB RTI.C43.PO2804.TUCC,'BURT PKBMAR',M=1,PRTY=0,T=(,45),      1
```

Figure 5. JCL and Input Data Cards for CAASE2

TABLE 3. TABLE OF INPUT VARIABLES, CAASE2

VARIABLE NAME	DEFINITION
NCNTY	Number of counties to be plotted
ITOT	Number of counties in the AQCR
AQCR	Name of Air Quality Control Region
IZONE	Primary UTM zone
EW	Direction of coordinate point conversion for primary zone when AQCR straddles UTM zones
SCALEX	Scaling factor to convert distances in kilometers to plotter inches
SCALEP	Scaling factor to convert population to circle radius in inches
TICINC	Distance between axes tick-marks in inches
XXZERO	Lower left-hand X coordinate of the selected county
YYZERO	Lower left-hand Y coordinate of the selected county
ICNTY	Federal county code for selected county
XCNTY	Name of selected county
IAXES	Axes flag signifying whether the standard axes will be used
ISTAT	Federal state code number for selected state
XSTAT	Name of selected state
XLONG	Length of X axis if standard X axis is too short
YLONG	Length of Y axis if standard Y axis is too short
XTIC	Number of tick-marks on lengthened X axis
YTIC	Number of tick-marks on lengthened Y axis

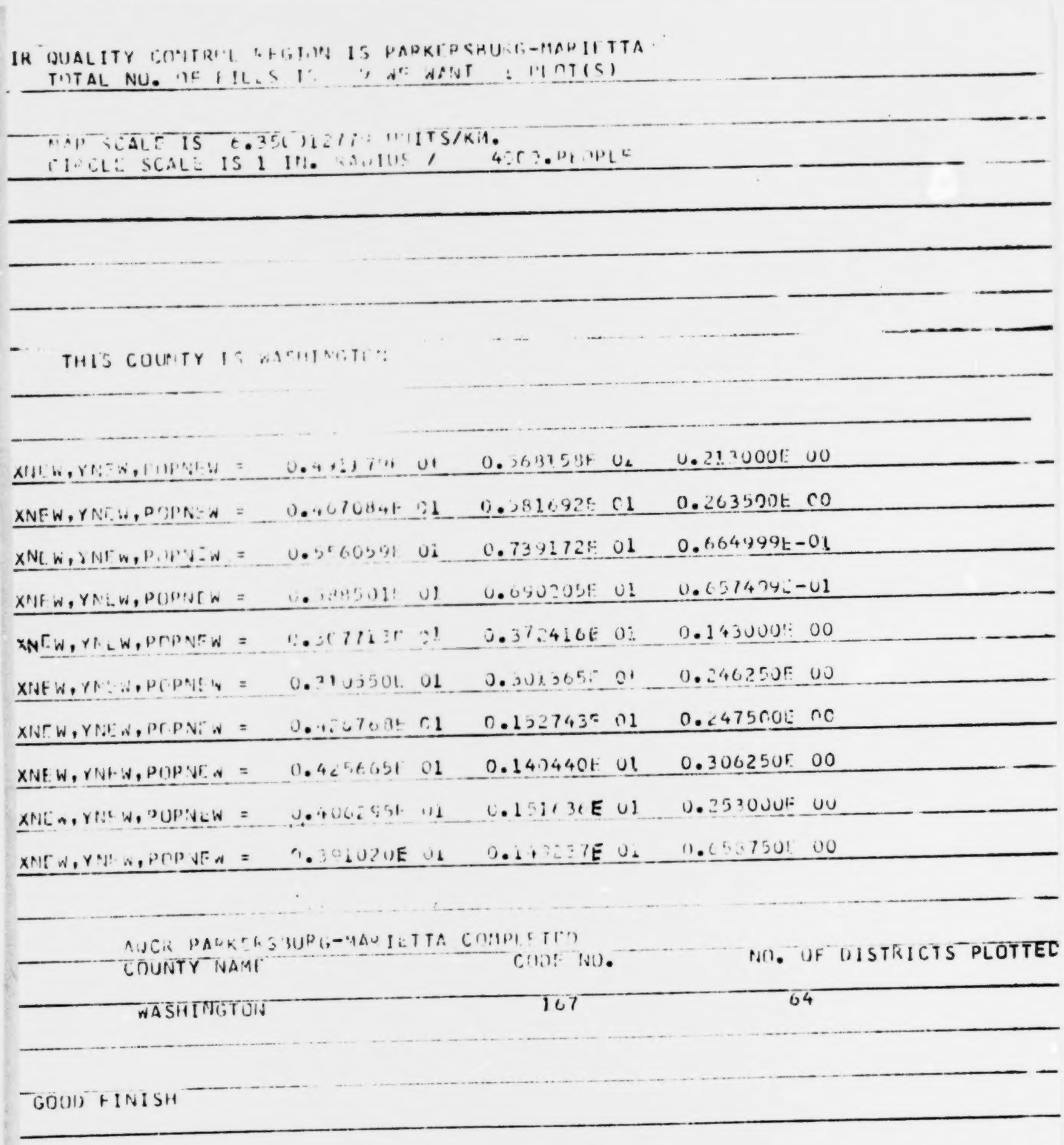
TABLE 4. INPUT CARD LAYOUT, CAASE2

CARD TYPE	COLUMNS	FORMAT	VARIABLE NAME
1	1-4	I4	NCNTY
	5-8	I4	ITOT
	9-28	5A4	AQCR
	31-35	I5	IZONE
	36-40	F5.0	EW
2	1-12	F12.0	SCALEX
	13-24	F12.0	SCALEP
	25-36	F12.0	TICINC
3*	1-10	F10.0	XXZERO
	11-20	F10.0	YYZERO
	21-24	I4	ICNTY
	25-48	6A4	XCNTY
	51-52	I2	IAXES
4*	1-4	I4	ISTAT
	5-16	3A4	XSTAT
5†	1-10	F10.0	XLONG
	11-20	F10.0	YLONG
	21-25	I5	XTIC
	26-30	I5	YTIC

---

*CARD TYPES 3 and 4 are repeated depending on number of counties to be plotted.

†CARD TYPE 5 is used ONLY if the county requires longer axes.



```
IR QUALITY CONTROL REGION IS PARKERSBURG-MARIETTA
  TOTAL NO. OF FILES IS  [illegible] WE WANT  1 PLOT(S)

  MAP SCALE IS  6.350012770 UNITS/KM.
  CIRCLE SCALE IS 1 IN. RADIUS /    4000.PEOPLE

    THIS COUNTY IS WASHINGTON

XNEW,YNEW,POPNEW =    0.4[illegible] 01   0.568158E 01   0.213000E 00
XNEW,YNEW,POPNEW =    0.467084E 01   0.581692E 01   0.263500E 00
XNEW,YNEW,POPNEW =    0.556059E 01   0.739172E 01   0.664999E-01
XNEW,YNEW,POPNEW =    0.588501E 01   0.690205E 01   0.657409E-01
XNEW,YNEW,POPNEW =    0.307713E 01   0.372416E 01   0.143000E 00
XNEW,YNEW,POPNEW =    0.310550E 01   0.301365E 01   0.246250E 00
XNEW,YNEW,POPNEW =    0.426768E 01   0.152743E 01   0.247500E 00
XNEW,YNEW,POPNEW =    0.425665E 01   0.140440E 01   0.306250E 00
XNEW,YNEW,POPNEW =    0.406295E 01   0.151736E 01   0.253000E 00
XNEW,YNEW,POPNEW =    0.391020E 01   0.149237E 01   0.655750E 00

        AQCR PARKERSBURG-MARIETTA COMPLETED
        COUNTY NAME                     CODE NO.         NO. OF DISTRICTS PLOTTED
         WASHINGTON                       107                 64

 GOOD FINISH
```

Figure 6. Example of a Printout from CAASE2

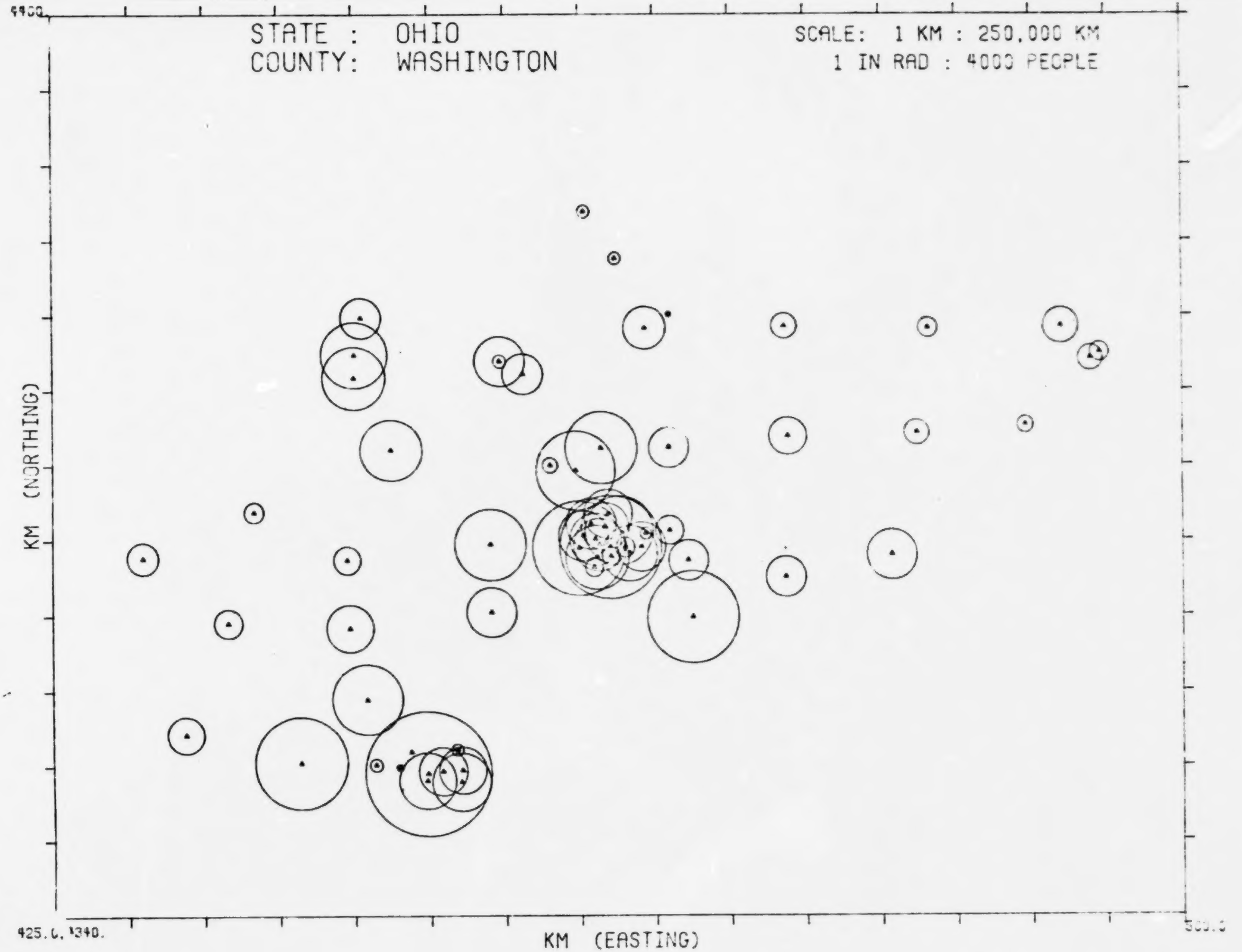


Figure 7. Example of a Plotter Output from CAASE2

4.0 CAASE3 PROGRAM

4.1 Program Description

The CAASE3 program is designed to draw area source grid squares for any given AQCR. It uses a set of data cards that define, for each grid square within the AQCR, the coordinates of the lower left-hand corner and the side length. The program is useful for identifying clerical errors or keypunching errors and for describing the locations and sizes of each of the grid squares within an AQCR. A scaling factor appropriate for the map with which the grid will be used may be input; the only restriction is the physical limitations of the plotter paper width. CAASE3 calls the subroutine POPBOX and provides to it the necessary information to drive the plotter to draw the AQCR grid. Subroutine POPBOX is described in Section 7.4. Because most AQCR's contain several counties, the 30-inch-wide paper probably will be necessary for CAASE3 plotting and an "operator message" requesting the wide paper is issued by the program in all cases. A flow chart of the program logic of CAASE3 appears in Appendix C.

4.2 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 2. The JCL cards associated with an example for the Parkersburg-Marietta AQCR are illustrated in Figure 8. The JCL configuration illustrated assumes the following:

a. The program is in object deck form.

b. The punched cards assigning values to the variables are in the job input stream.

c. The punched cards describing the grid squares and their locations are in the job input stream.

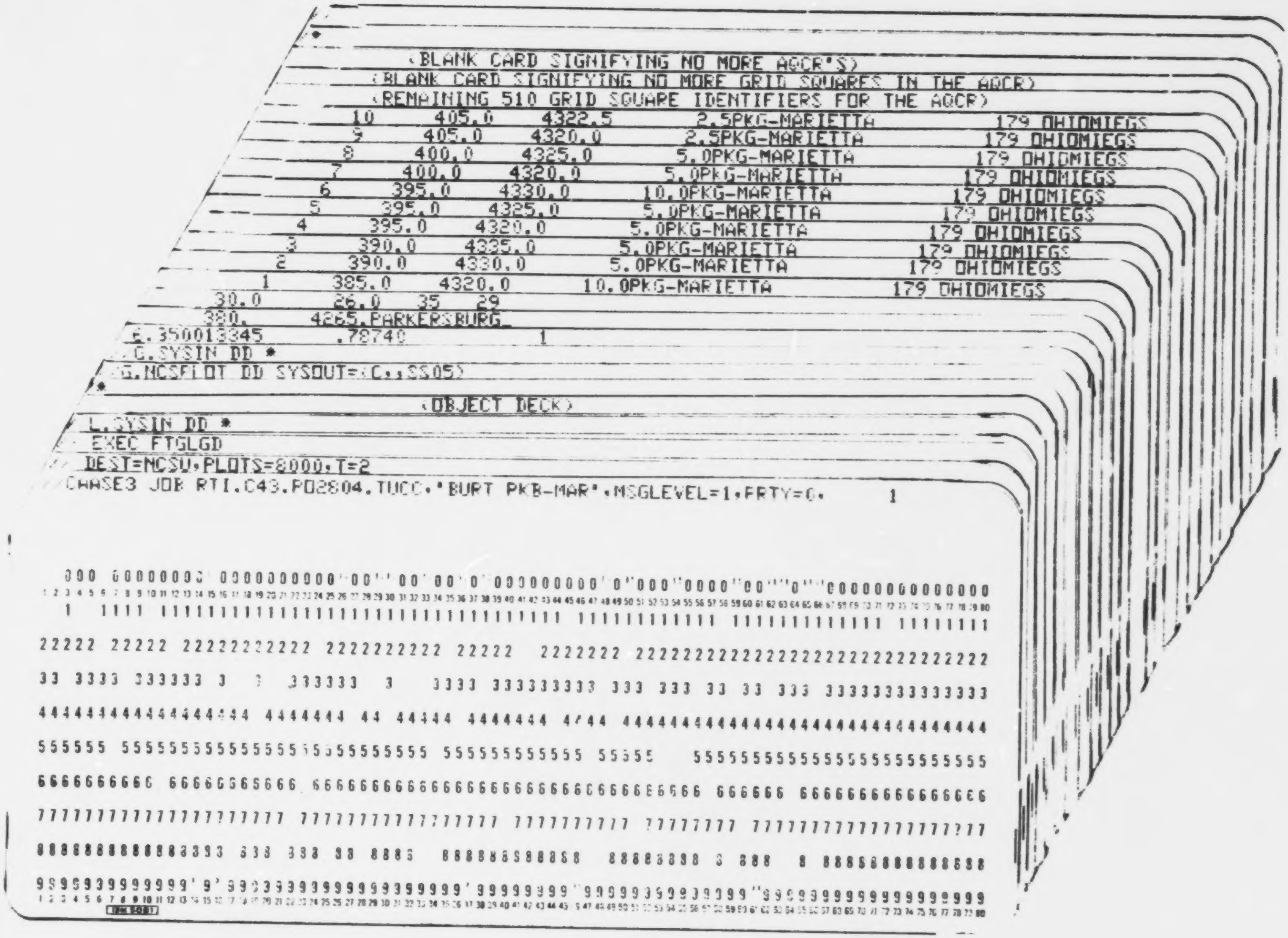
d. Only one Air Quality Control Region (AQCR) is to be plotted.

4.3 Input Information

All input to the CAASE3 program is through punched cards in the input stream. The punched card input variables appear in Table 5. Input variables define the scaling factor, the UTM coordinates of the lower left-hand corner of the entire AQCR, the AQCR name, the length in plotter space inches of both the X and Y axes, the number of tick-marks wanted on both the X and Y axes, the spacing of the tick-marks, and a card for each grid square in the AQCR which contains the identification number of the grid square, the UTM coordinates of the lower left-hand corner, and the side length of the grid square. The input card layout is described in Table 6.

4.4 Output Information

In addition to a computer driven plotter output of all grid squares (see Figure 9 for an example) within the AQCR drawn to scale, error messages, when necessary, and a listing of input data are printed. Figure 10 is an example of the printed output.



```
*
          (BLANK CARD SIGNIFYING NO MORE AQCR'S)
        (BLANK CARD SIGNIFYING NO MORE GRID SQUARES IN THE AQCR)
        (REMAINING 510 GRID SQUARE IDENTIFIERS FOR THE AQCR)
       10     405.0     4322.5        2.5PKG-MARIETTA             179 OHIOMIEGS
        9     405.0     4320.0        2.5PKG-MARIETTA             179 OHIOMIEGS
        8     400.0     4325.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        7     400.0     4320.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        6     395.0     4330.0       10.0PKG-MARIETTA             179 OHIOMIEGS
        5     395.0     4325.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        4     395.0     4320.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        3     390.0     4335.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        2     390.0     4330.0        5.0PKG-MARIETTA             179 OHIOMIEGS
        1     385.0     4320.0       10.0PKG-MARIETTA             179 OHIOMIEGS
    30.0      26.0   35   29
    380.      4265.PARKERSBURG
E.350013345       .78740           1
G.SYSIN DD *
G.MCSPLOT DD SYSOUT=(C,,SS05)
*
                     (OBJECT DECK)
L.SYSIN DD *
 EXEC FTGLGD
 DEST=MCSU,PLOTS=8000,T=2
CAASE3 JOB RTI.C43.P02804.TUCC,'BURT PKB-MAR',MSGLEVEL=1,PRTY=0,      1
```

Figure 8. JCL and Input Data Cards for CAASE3

TABLE 5. TABLE OF INPUT VARIABLES, CAASE3

VARIABLE NAME	DEFINITION
SCALEX	Scaling factor to convert distances in kilometers to plotter inches
TICINC	Distance between axes tick-marks in inches
XZERO	Lower left-hand X coordinate for entire AQCR
YZERO	Lower left-hand Y coordinate for entire AQCR
AQCR	Name of selected Air Quality Control Region
XLONG	Length of X axis
YLONG	Length of Y axis
IXTIC	Number of tick-marks on X axis
IYTIC	Number of tick-marks on Y axis
IBOX	Area source grid square number
XPT	Lower left-hand X coordinate for the grid square
YPT	Lower left-hand Y coordinate for the grid square
S	Length of the side of the grid square
CNTY	Name of county to which grid square belongs

TABLE 6. INPUT CARD LAYOUT, CAASE3

CARD TYPE	COLUMNS	FORMAT	VARIABLE NAME
1	1-12	F12.0	SCALEX
	13-24	F12.0	TICINC
2	1-10	F10.0	XZERO
	11-20	F10.0	YZERO
	21-40	5A4	AQCR
3	1-10	F10.0	XLONG
	11-20	F10.0	YLONG
	21-25	I5	IXTIC
	26-30	I5	IYTIC
4*	1-10	I10	IBOX
	11-20	F10.0	XPT
	21-30	F10.0	YPT
	31-40	F10.0	S
	71-78	2A4	CNTY
5	A blank card indicating no more grid squares for this AQCR.		
6	A blank card indicating no more AQCR's to be gridded.		

---

*CARD TYPE 4 is repeated for each grid square in the AQCR.

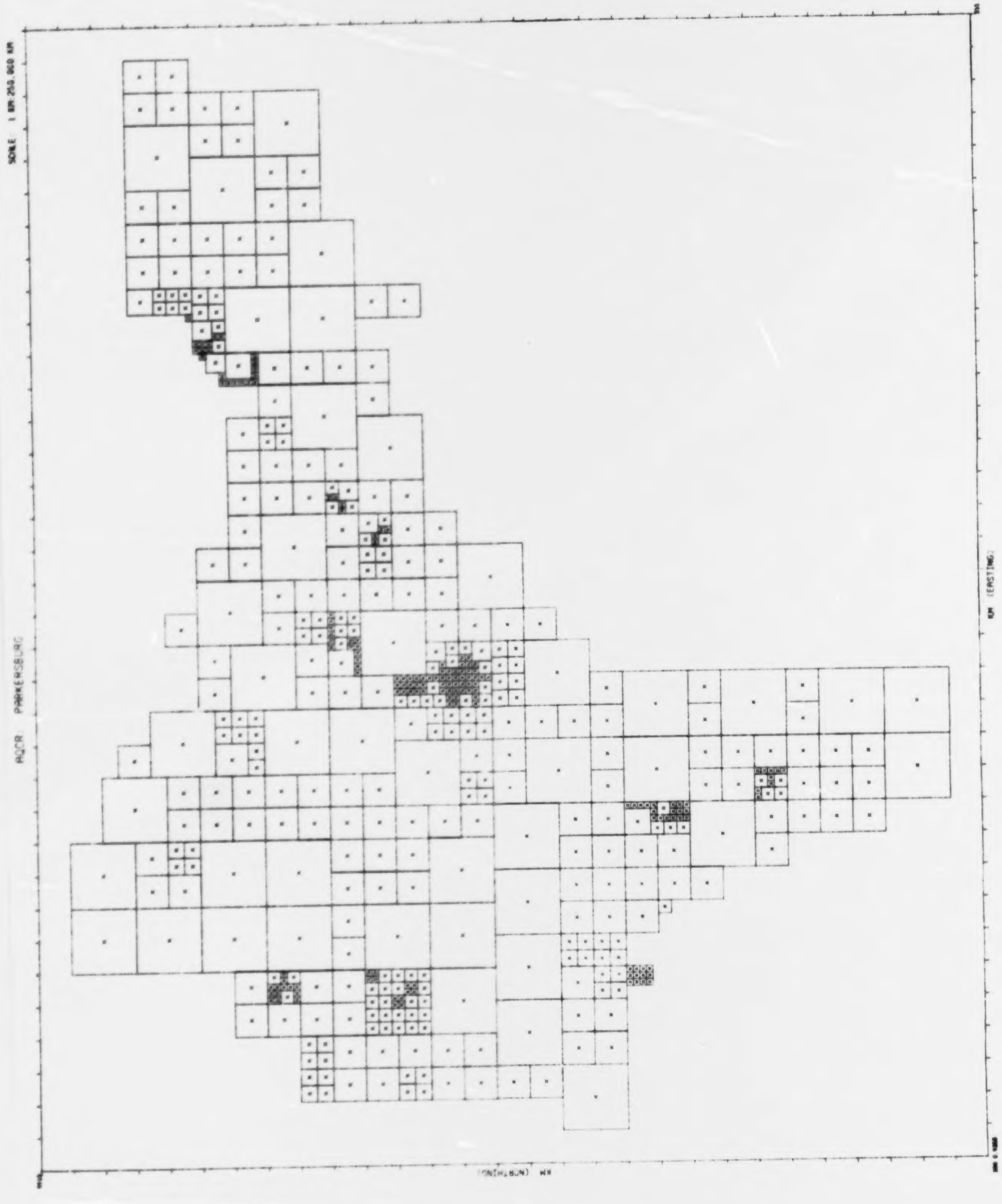

SCALE 1 KM:250.000 KM
AQCR: PARKERSBURG
KM (EASTING)
KM (NORTHING)

Figure 9. Example of a Plotter Output from CAASE3
(Figure Optically Reduced)

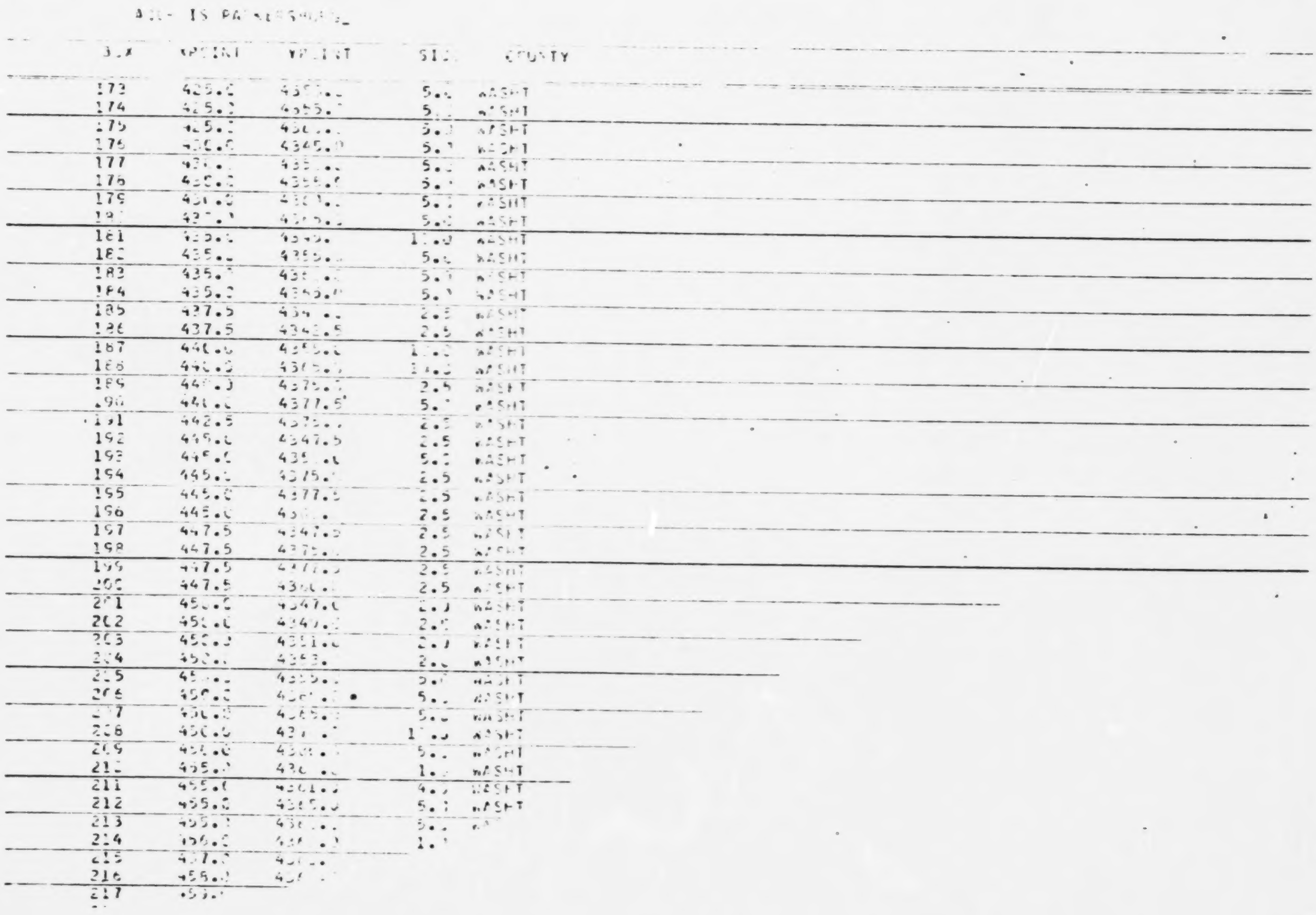


Figure 10. Example of a Printer Output from CAASE3

5.0 CAASE4 PROGRAM

5.1 Description of Program

The CAASE4 apportioning factor program uses the edited MED-X data files, with UTM coordinates (output from CAASE1) and cards describing the lower left-hand corner and side length of each area source grid square and processes the census data to sum all of the population and housing counts for all enumeration districts with centers falling within each individual grid square. The area of each grid square is also calculated. Because the MED-X data locates the geographical center of the enumeration district, the basic question is whether the center falls within the geographic outline of the grid square. These population summations, housing summations, and areas for each grid square are objective factors used in the apportioning of total county emissions, for each of the source emissions categories, into grid squares of unequal size which have been subjectively located using graphical outputs from CAASE2. Because there are source categories, e.g. airports, which do not lend themselves to objective apportioning based on population, housing, or area, provisions are made in the CAASE4 program to input, as overriding weighting factors, any information known to the technical personnel gridding the county (or counties) within the AQCR and apportioning the county total emissions. These weighting factors override the objective apportioning factors. A detailed discussion of the objective apportioning factors and the overriding apportioning weighting factors, their rationale, and how to apply them, are included in Section 9.0 of this manual.

For convenience, the several fields of "fuel" data on the Area Source Input Form EPA (DUR) 219 3/72 have been sequentially numbered for category number, major classification (residential fuel, industrial fuel, etc.), and minor classification (anthracite coal, bituminous coal, distillate oil, etc.). Table 7 relates the category number to its major and minor classifications, and the method of introducing overriding apportioning factors is discussed in Section 5.3, Input Data.

The CAASE4 program also relates all locations to a common origin, i.e., in using the CAASE1 output tape of census data, more than one UTM zone may be encountered;

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TABLE 7. AREA SOURCE EMISSIONS CATEGORY NUMBERS

CATEGORY NUMBER	MAJOR CLASSIFICATION	MINOR CLASSIFICATION
1	RESIDENTIAL FUEL	ANTHRACITE COAL
2	RESIDENTIAL FUEL	BITUMINOUS COAL
3	RESIDENTIAL FUEL	DISTILLATE OIL
4	RESIDENTIAL FUEL	RESIDUAL OIL
5	RESIDENTIAL FUEL	NATURAL GAS
6	RESIDENTIAL FUEL	WOOD
7	COMMERCIAL & INSTITUTIONAL FUEL	ANTHRACITE COAL
8	COMMERCIAL & INSTITUTIONAL FUEL	BITUMINOUS COAL
9	COMMERCIAL & INSTITUTIONAL FUEL	DISTILLATE OIL
10	COMMERCIAL & INSTITUTIONAL FUEL	RESIDUAL OIL
11	COMMERCIAL & INSTITUTIONAL FUEL	NATURAL GAS
12	COMMERCIAL & INSTITUTIONAL FUEL	WOOD
13	INDUSTRIAL FUEL	ANTHRACITE COAL
14	INDUSTRIAL FUEL	BITUMINOUS COAL
15	INDUSTRIAL FUEL	COKE
16	INDUSTRIAL FUEL	DISTILLATE OIL
17	INDUSTRIAL FUEL	RESIDUAL OIL
18	INDUSTRIAL FUEL	NATURAL GAS
19	INDUSTRIAL FUEL	WOOD
20	INDUSTRIAL FUEL	PROCESS GAS
21	ON-SITE INCINERATION	RESIDENTIAL
22	ON-SITE INCINERATION	INDUSTRIAL
23	ON-SITE INCINERATION	COMMERCIAL & INSTITUTIONAL FUEL
24	OPEN BURNING	RESIDENTIAL
25	OPEN BURNING	INDUSTRIAL
26	OPEN BURNING	COMMERCIAL & INSTITUTIONAL FUEL
27	GASOLINE FUEL	LIGHT VEHICLE
28	GASOLINE FUEL	HEAVY VEHICLE
29	GASOLINE FUEL	OFF-HIGHWAY
30	DIESEL FUEL	HEAVY VEHICLE
31	DIESEL FUEL	OFF-HIGHWAY
32	DIESEL FUEL	RAIL LOCOMOTIVE
33	AIRCRAFT	MILITARY
34	AIRCRAFT	CIVIL
35	AIRCRAFT	COMMERCIAL
36	VESSELS	ANTHRACITE COAL
37	VESSELS	DIESEL OIL
38	VESSELS	RESIDUAL OIL
39	VESSELS	GASOLINE
40	EVAPORATION	SOLVENT PURCHASED
41	EVAPORATION	GASOLINE MARKETED
42	MEASURED VEHICLE MILES	LIMITED ACCESS ROADS
43	MEASURED VEHICLE MILES	RURAL ROADS
44	MEASURED VEHICLE MILES	SUBURBAN ROADS
45	MEASURED VEHICLE MILES	URBAN ROADS
46	DIRT ROADS TRAVELED	...
47	DIRT AIRSTRIPS	...
48	CONSTRUCTION LAND AREA	...
49	ROCK HANDLING & STORING	...
50	FOREST FIRES*	AREA-ACRES
51	SLASH BURNING*	AREA-ACRES
52	FROST CONTROL**	ORCHARD HEATERS
53	STRUCTURE FIRES	NUMBER PER YEAR
54	COAL REFUSE BURNING***	SIZE OF BANK

---

*Tons/acre also reported; **Days/yr. fired also reported; ***Number/yr. also reported.

therefore, a primary zone is declared on an input card and those points falling outside the primary zone have their UTM coordinates converted to the primary zone. The conversion is made using subroutine GTGR which is described in Section 7.2. In the CAASE4 program objective apportioning factors have been assigned for all area source emission categories, even though emission factors have not yet been determined for some. CAASE4 will not require modification (except to change the coefficient from zero) when these emission factors are determined. The tons per acre coefficients reported on the Area Source Form No. EPA (DUR) 219 3/72 for forest fires and slash burning is used to calculate total county "fuels" for those source categories and are therefore not subject to apportioning; their numeric value is included in CAASE4 outputs for use by CAASE5. The number of days orchard heaters are fired for frost control and the number of burns/year of coal refuse banks are also output without change for use by CAASE5. A logical flow chart describing CAASE4 is included in Appendix D.

5.2 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 2. The JCL cards associated with an example for the Parkersburg-Marietta AQCR are illustrated in Figure 11. The JCL configuration illustrated assumes the following:

a. The program is in object deck form.

b. The punched cards assigning values to the variables are in the job input stream.

c. Population data, output from CAASE1, are on magnetic tape as files 1 through 9 on reel number RED087.

d. The number of counties to be processed is nine.

e. The tables used by the GTGR subroutine are on disk volume "RTIEES" with data set name (DSN) of "GRDTB66."

f. No overriding apportioning weighting factors are input.

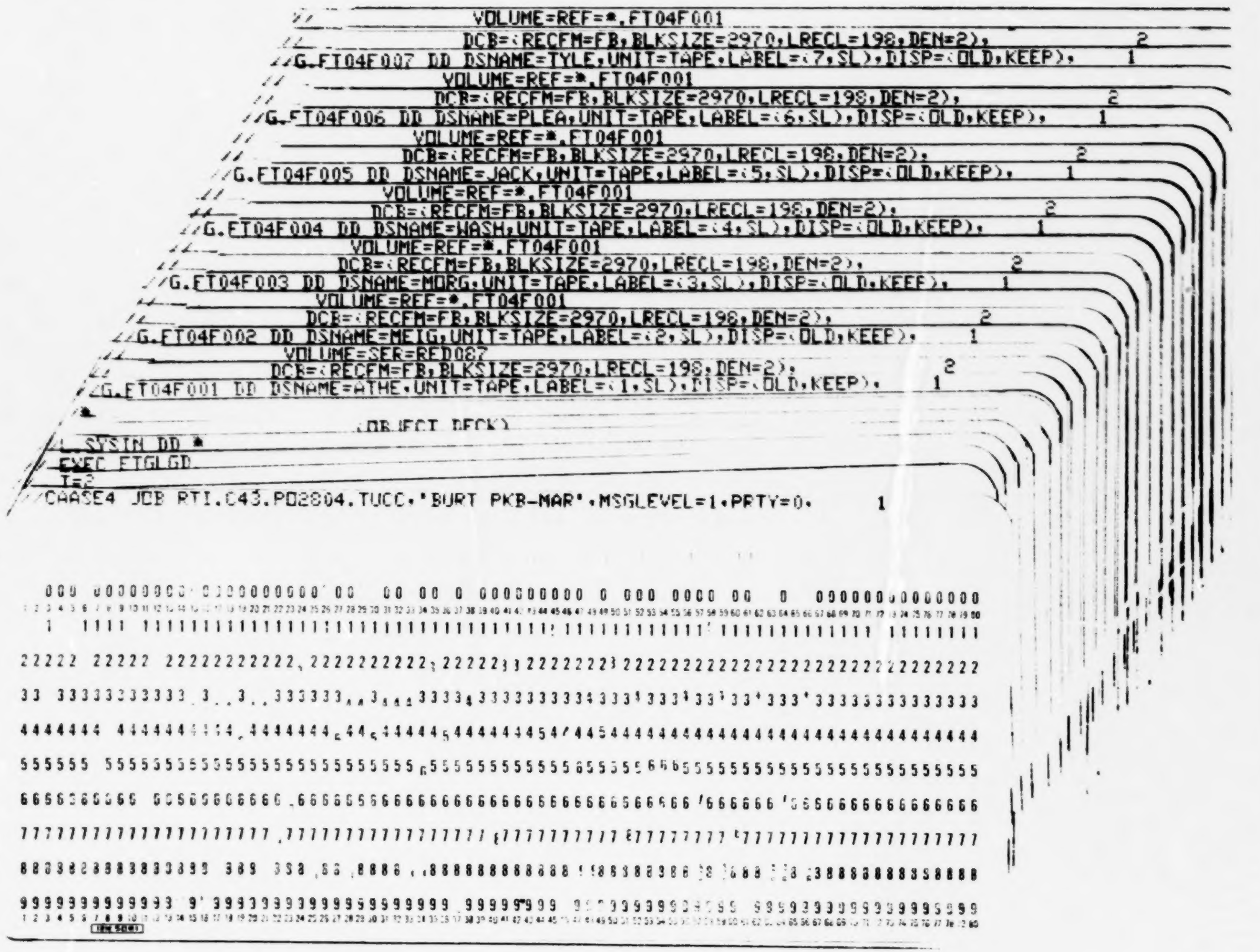
g. Output of apportioning factors is on binary tape as files 1 through 9 on reel number RED141 (for later use by CAASE5).

5.3 Input Information

The punched card input variables appear in Table 8. They include the county, region, political subdivision, county name, primary UTM zone number, a print switch option variable, and a direction variable to convert coordinates when an AQCR straddles UTM zone boundaries. The same grid square identification cards which were used as input to the CAASE3 program are used as input to CAASE4; that is, a card is input for each grid square containing its sequential identification number, UTM coordinates of the lower left-hand corner, and its side length in kilometers. Overriding weighting factor cards are read in until a blank card is encountered. Each weighting factor card includes the identification number of a grid square, a source category number, and the weighting value to be assigned. A card is necessary for each grid square and source category combination for which an overriding weighting factor is to be input. The edited MED-X tape, output from CAASE1, is read by the program a record at a time, and the housing counts and population counts are summed into the grid square into which each enumeration district center falls. If a decision is made at processing time to assign equal weighting factors to some normally overridden source category, such as railroads, then it is suggested that the FORTRAN source language statement be inserted near the end of the weighting factor initialization loop to set the coefficient (weighting factor) to 1.0 instead of 0. This will preclude the necessity of inputting a large volume of cards. The description of the input card layout appears in Table 9.

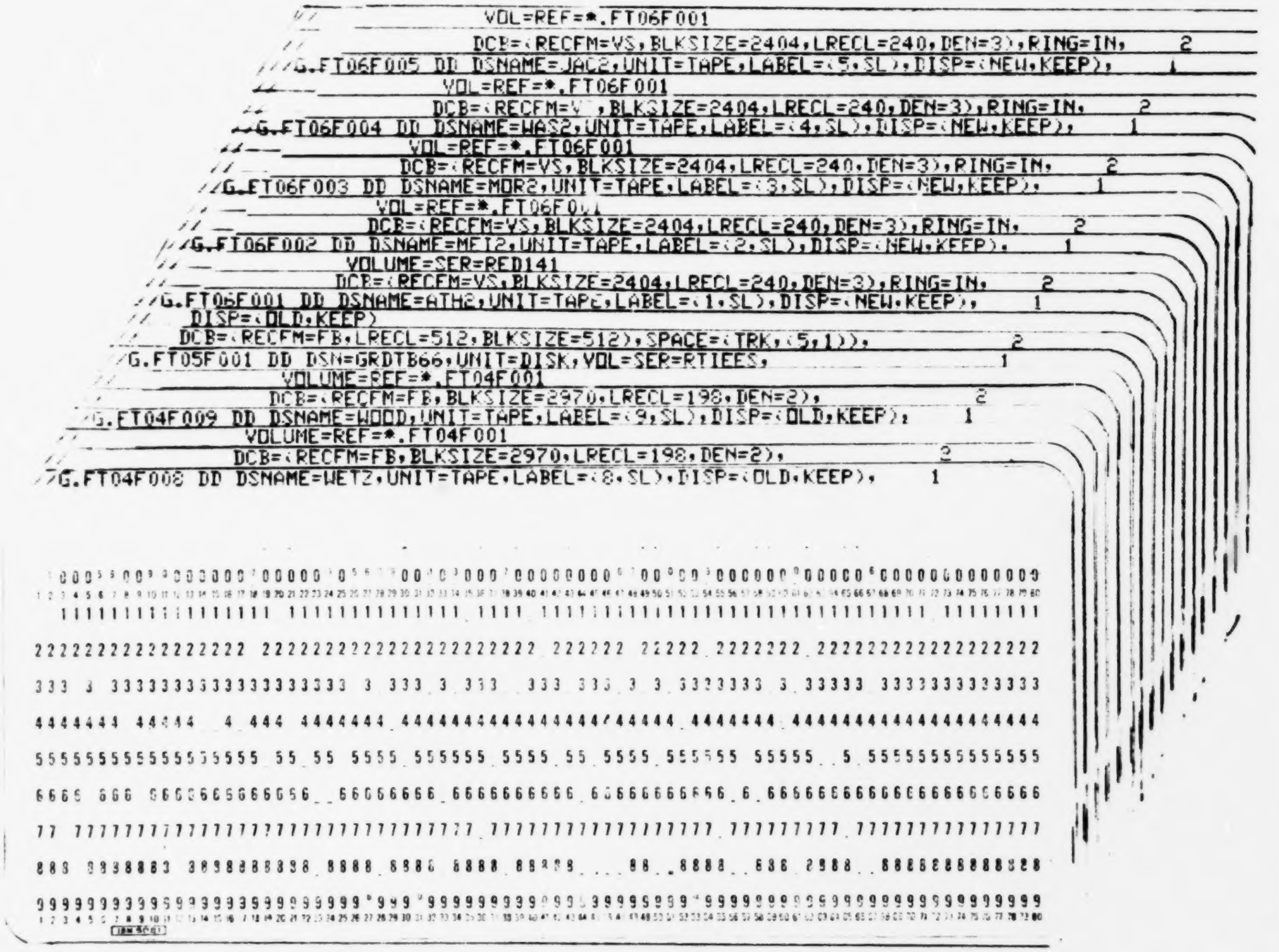
5.4 Output Information

Error messages, diagnostic messages, information necessary to control the CAASE5 program, and a magnetic tape with grid square descriptors and their weighted apportioning factors are output. The county, region, political subdivision, and county name from the input information are printed. For each county, the grid square number, category number, and weighting factor number for each overriding weighting factor read in are printed; the total count of overriding weighting factors is also printed. The total number of grid squares for each county is printed. Error and diagnostic messages (and suggested responses) include: the number of grid squares for a county exceeds the program dimensions (increase the dimensions and rerun); a category number on an overriding weighting factor input card is out of range (correct it); the grid square number on an overriding weighting factor card does not match any of the set for the county being processed (correct the set or the card); a message when the county number on the tape input file and the one on the input card do not match (JCL or input card error, correct it); any error messages from grid-to-grid coordinate conversion routine GTGR (see Section 7.2.3); and an optional print of census data and UTM coordinates. If an enumeration district's coordinates are not located inside any grid square uniquely assigned to the county being processed, its county number, UTM coordinates, population, and housing counts are printed. The coordinates should be checked on the total AQCR grid against the following possibilities: 1) the coordinates are not located within the county and are therefore incorrect on the census record, 2) the grid square in which the coordinates are located was either assigned to the wrong county, was not included in the deck, or was keypunched wrong, 3) it was not possible to draw a grid square at the county border without including an enumeration district from an adjacent county and a compromise was made. The apportioning factor computed for each grid square can also be optionally printed. Figure 12 is an example of the printout from the processing of the Parkersburg-Marietta AQCR.



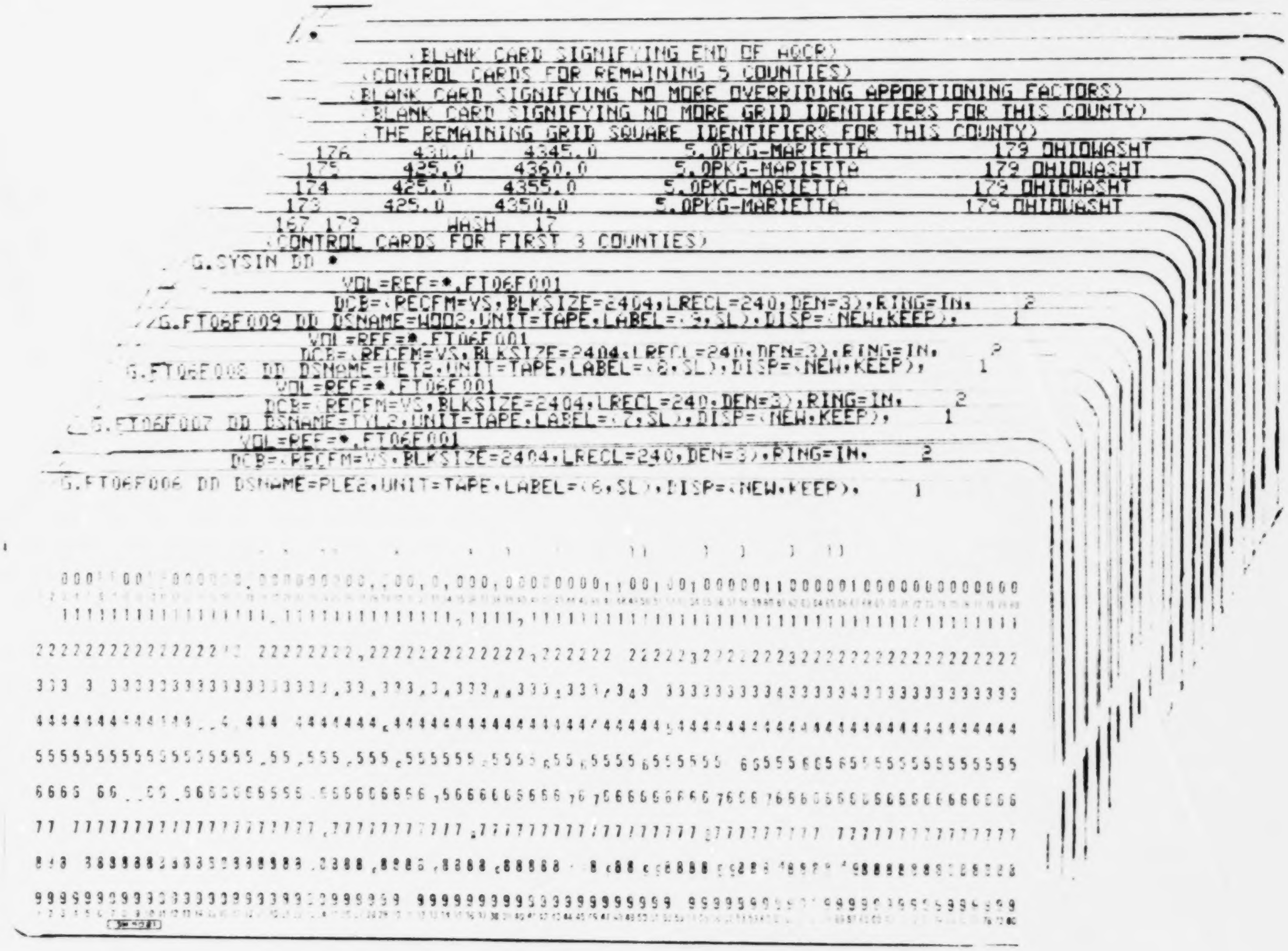
```
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F007 DD DSNAME=TYLE,UNIT=TAPE,LABEL=(7,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F006 DD DSNAME=PLEA,UNIT=TAPE,LABEL=(6,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F005 DD DSNAME=JACK,UNIT=TAPE,LABEL=(5,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F004 DD DSNAME=WASH,UNIT=TAPE,LABEL=(4,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F003 DD DSNAME=MORG,UNIT=TAPE,LABEL=(3,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=REF=*.FT04F001
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F002 DD DSNAME=MEIG,UNIT=TAPE,LABEL=(2,SL),DISP=(OLD,KEEP),        1
//                    VOLUME=SER=RED087
//                    DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),          2
//G.FT04F001 DD DSNAME=ATHE,UNIT=TAPE,LABEL=(1,SL),DISP=(OLD,KEEP),        1
/*
                    (OBJECT DECK)
// SYSIN DD *
// EXEC FTGLGD
// I=2
//CAASE4 JOB RTI.C43.PD2804.TUCC,'BURT PKB-MAR',MSGLEVEL=1,PRTY=0,        1
```

Figure 11. JCL and Input Data Cards for CAASE4



```
//              VOL=REF=*.FT06F001
//                  DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,     2
//G.FT06F005 DD DSNAME=JAC2,UNIT=TAPE,LABEL=(5,SL),DISP=(NEW,KEEP),        1
//              VOL=REF=*.FT06F001
//                  DCB=(RECFM=V ,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,     2
//G.FT06F004 DD DSNAME=WAS2,UNIT=TAPE,LABEL=(4,SL),DISP=(NEW,KEEP),        1
//              VOL=REF=*.FT06F001
//                  DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,     2
//G.FT06F003 DD DSNAME=MOR2,UNIT=TAPE,LABEL=(3,SL),DISP=(NEW,KEEP),        1
//              VOL=REF=*.FT06F001
//                  DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,     2
//G.FT06F002 DD DSNAME=MEI2,UNIT=TAPE,LABEL=(2,SL),DISP=(NEW,KEEP),        1
//              VOLUME=SER=RED141
//                  DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,     2
//G.FT06F001 DD DSNAME=ATH2,UNIT=TAPE,LABEL=(1,SL),DISP=(NEW,KEEP),        1
//   DISP=(OLD,KEEP)
//   DCB=(RECFM=FB,LRECL=512,BLKSIZE=512),SPACE=(TRK,(5,1)),               2
//G.FT05F001 DD DSN=GRDTB66,UNIT=DISK,VOL=SER=RTIEES,                      1
//              VOLUME=REF=*.FT04F001
//                  DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),             2
//G.FT04F009 DD DSNAME=WOOD,UNIT=TAPE,LABEL=(9,SL),DISP=(OLD,KEEP),        1
//              VOLUME=REF=*.FT04F001
//                  DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),             2
//G.FT04F008 DD DSNAME=WETZ,UNIT=TAPE,LABEL=(8,SL),DISP=(OLD,KEEP),        1
```

Figure 11. (Continued)



```
/*
      (BLANK CARD SIGNIFYING END OF HOCR)
     (CONTROL CARDS FOR REMAINING 5 COUNTIES)
    (BLANK CARD SIGNIFYING NO MORE OVERRIDING APPORTIONING FACTORS)
     (BLANK CARD SIGNIFYING NO MORE GRID IDENTIFIERS FOR THIS COUNTY)
     (THE REMAINING GRID SQUARE IDENTIFIERS FOR THIS COUNTY)
   176      430.0     4345.0         5.0PKG-MARIETTA            179 OHIOWASHT
   175      425.0     4360.0         5.0PKG-MARIETTA            179 OHIOWASHT
   174      425.0     4355.0         5.0PKG-MARIETTA            179 OHIOWASHT
   173      425.0     4350.0         5.0PKG-MARIETTA            179 OHIOWASHT
  167 179         WASH   17
 (CONTROL CARDS FOR FIRST 3 COUNTIES)
//G.SYSIN DD *
//             VOL=REF=*.FT06F001
//             DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,      2
//G.FT06F009 DD DSNAME=WOO2,UNIT=TAPE,LABEL=(9,SL),DISP=(NEW,KEEP),      1
//             VOL=REF=*.FT06F001
//             DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,      2
//G.FT06F008 DD DSNAME=WET2,UNIT=TAPE,LABEL=(8,SL),DISP=(NEW,KEEP),      1
//             VOL=REF=*.FT06F001
//             DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,      2
//G.FT06F007 DD DSNAME=TYL2,UNIT=TAPE,LABEL=(7,SL),DISP=(NEW,KEEP),      1
//             VOL=REF=*.FT06F001
//             DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),RING=IN,      2
//G.FT06F006 DD DSNAME=PLE2,UNIT=TAPE,LABEL=(6,SL),DISP=(NEW,KEEP),      1
```

Figure 11. (Continued)

TABLE 8. TABLE OF INPUT VARIABLES, CAASE4

VARIABLE NAME	DEFINITION
ICNTY	Federal county code number for selected county
IREGN	Code number of selected AQCR
IPOLT	Code number of political subdivision of AQCR
CNTY1	Name of selected county
KZON	Primary UTM zone number
ITEST	Print switch option
EW	Direction to convert coordinates when AQCR straddles two UTM zone boundaries
ID	Area source grid square number
X	Lower left-hand X coordinate of the grid square
Y	Lower left-hand Y coordinate of the grid square
SIDE	Length of the side of the grid square
IDNUM	Area source grid square number for overriding weighting factor
ICAT	Source category number for overriding weighting factor (see Table 7)
WEIGHT	Overriding weighting factor for selected grid square-source category

TABLE 9. INPUT CARD LAYOUT, CAASE4

CARD TYPE	COLUMNS	FORMAT	VARIABLE NAME
1[*]	1-10	I10	ICNTY
	12-14	A3	IREGN
	16-20	I5	IPOLT
	22-25	A4	CNTY1
	26-30	I5	KZON
	31-35	I5	ITEST
	36-40	F5.0	EW
2[†]	1-10	I10	ID
	11-20	F10.0	X
	21-30	F10.0	Y
	31-40	F10.0	SIDE
3	A blank card signifying no more grids for this county.		
4[§]	1-10	I10	IDNUM
	11-20	I10	ICAT
	21-30	F10.0	WEIGHT
5[¶]	A blank card signifying no more overriding weighting factors for this county.		

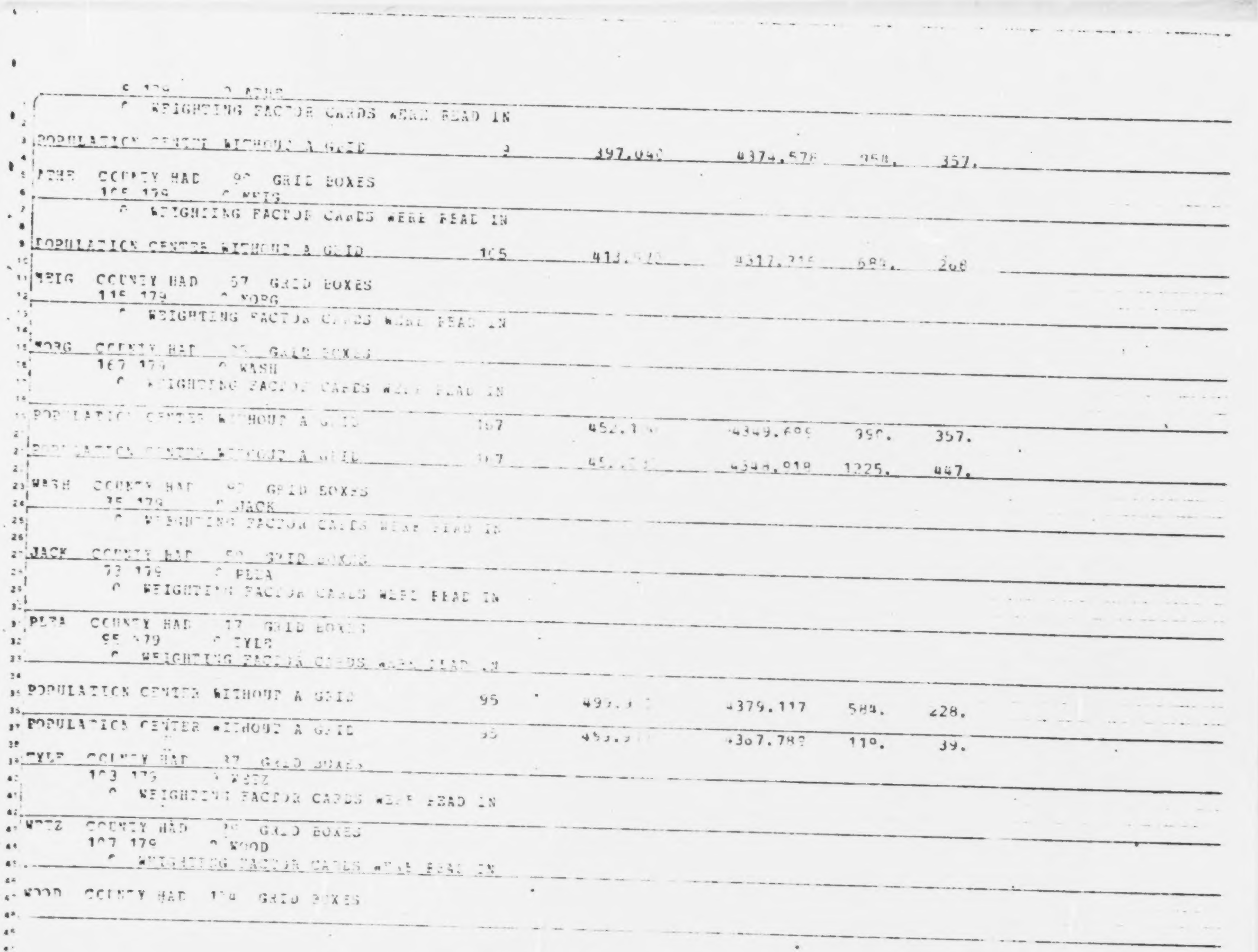
---

[*] CARD TYPE 1 is repeated for each county in the AQCR and follows CARD TYPE 5.

[†] CARD TYPE 2 is repeated for each grid square in the county.

[§] CARD TYPE 4 is repeated for each overriding weighting factor for the county's grid squares.

[¶] A blank card follows CARD TYPE 5 when there are no more counties in the AQCR.



```
       5 179       0 ATHE
          0  WEIGHTING FACTOR CARDS WERE READ IN
POPULATION CENTER WITHOUT A GRID              9      397.040       4374.578    958.    357.
ATHE  COUNTY HAD   9[illegible]  GRID BOXES
       165 179        0 MEIG
          0  WEIGHTING FACTOR CARDS WERE READ IN
POPULATION CENTER WITHOUT A GRID            165      413.[illegible]   4317.[illegible]   68[illegible].    268
MEIG  COUNTY HAD   57  GRID BOXES
       115 179        0 MORG
          0  WEIGHTING FACTOR CARDS WERE READ IN
MORG  COUNTY HAD   [illegible]  GRID BOXES
       167 179        0 WASH
          0  WEIGHTING FACTOR CARDS WERE READ IN
POPULATION CENTER WITHOUT A GRID            167      452.1[illegible]   4349.609    390.    357.
POPULATION CENTER WITHOUT A GRID            167      45[illegible]   4344.919   1225.    447.
WASH  COUNTY HAD   [illegible]  GRID BOXES
        75 179        0 JACK
          0  WEIGHTING FACTOR CARDS WERE READ IN
JACK  COUNTY HAD   5[illegible]  GRID BOXES
        73 179        0 PLEA
          0  WEIGHTING FACTOR CARDS WERE READ IN
PLEA  COUNTY HAD   17  GRID BOXES
        95 179        0 TYLE
          0  WEIGHTING FACTOR CARDS WERE READ IN
POPULATION CENTER WITHOUT A GRID             95      49[illegible]   4379.117    589.    228.
POPULATION CENTER WITHOUT A GRID             95      49[illegible]   4307.789    110.     39.
TYLE  COUNTY HAD   37  GRID BOXES
       103 179        0 WETZ
          0  WEIGHTING FACTOR CARDS WERE READ IN
WETZ  COUNTY HAD   [illegible]  GRID BOXES
       107 179        0 WOOD
          0  WEIGHTING FACTOR CARDS WERE READ IN
WOOD  COUNTY HAD  1[illegible]4  GRID BOXES
```

Figure 12. Example of a Printout from CAASE4

6.0 CAASE5 PROGRAM

6.1 Program Description

The CAASE5 emissions calculation and apportioning program uses the apportioning factors output from CAASE4, the "fuels" totals from the NEDS file for each county, and the emissions factors for each emissions source category. It calculates the total emissions for the county, and then apportions ("SMEARS") them into the grid squares within the county according to the apportioning factors output from CAASE4. If so little is known about an emission source category that the associated emission factor has not been determined, that emission factor is set as zero in the CAASE5 program. If in the future an emission factor is determined for the source category, the zero is easily replaced by the new factor. The CAASE5 program calculates the same total emissions for a county as does the NEO3 program. The program uses subroutines READ1, OUTPT1, OUTPT2, and OUTPT3 which are described in other sections of this manual. Emissions factors, by source category and by pollutants are defined in FORTRAN DATA statements. In the FORTRAN source language code, the DATA statement named "EFHV" defines the emissions factors for highway vehicles, and the DATA statements "EMFAC1," "EMFAC2," "EMFAC3," "EMFAC4," and "EMFAC5" define the emission factors, scaled for units of fuel, that are used in calculating the emissions. Because some of the fuels are reported in tens of tons, hundreds of tons, thousands of gallons, etc., the emission factors include these scaling factors. For example, if 20 lbs. of suspended particles are produced by the burning of a ton of fuel, and the fuels totals are reported in tens of tons, then the emission factor would be multiplied by ten but, because the output is in tons of pollutant, the resulting number would then be divided by 2,000 which would yield a coefficient of .10, indicating that for every ten tons of fuel burned, .1 tons of particulates would be produced. If the units for reporting the fuel totals are ever changed, then the change would have to be reflected in these scaled emission factors.

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When the CAASE5 program and its I/O subroutines were first written, the assumption had been made that 200 grid squares would adequately apportion emissions in any county being processed and that most counties could be adequately described with less than 100 grid squares. The total computer core storage requirements for a "job" was one of the terms included in the algorithm for computing computer charges on the system used to develop and apply the CAASE system; priority, volume of input/output, and the class of peripherals used were other terms. In early applications, the dimension terms in the storage arrays that were a function of the number of grid squares in a county were modified in the source language deck if any county being processed required more than 100 grid squares. The CAASE5 program was later modified, to its present form, whereby a five-statement "driving" program is used to set the dimensions for CAASE5 and its subroutines. CAASE5 is then, technically, a subroutine to the dimension setting "main" (driving) program; the main program has been compiled for each computer run using the variable "NDIM" as the maximum number of grid squares in any county being processed. In the processing of several AQCR's with a wide range of the number of grid squares within each county, a linear relationship was plotted of the actual core storage used by the load module (in thousands of bytes) and the maximum number of grid squares (denoted by the variable "NDIM") in any county being processed during a particular computer run; the regression line plotted in Figure 13 has been successfully used to estimate core storage requirements. As can be seen by inspecting Figure 13 the approximate core storage requirements, in K bytes, equals 0.45 times NDIM + 60, i.e. slope of 0.45 and an intercept of 60K bytes. Figure 14 is an example of a run where the county being processed (Washington County, Ohio) contained 92 grid squares; the driving program dimensions which were a function of the number of grid squares were set to 100 and the variable NDIM passed these adjustable dimensions to CAASE5 and its subroutines through the "call argument lists."

The sequence of steps performed by the CAASE5 program is repeated for each county being processed and is described as follows: First, identification information for

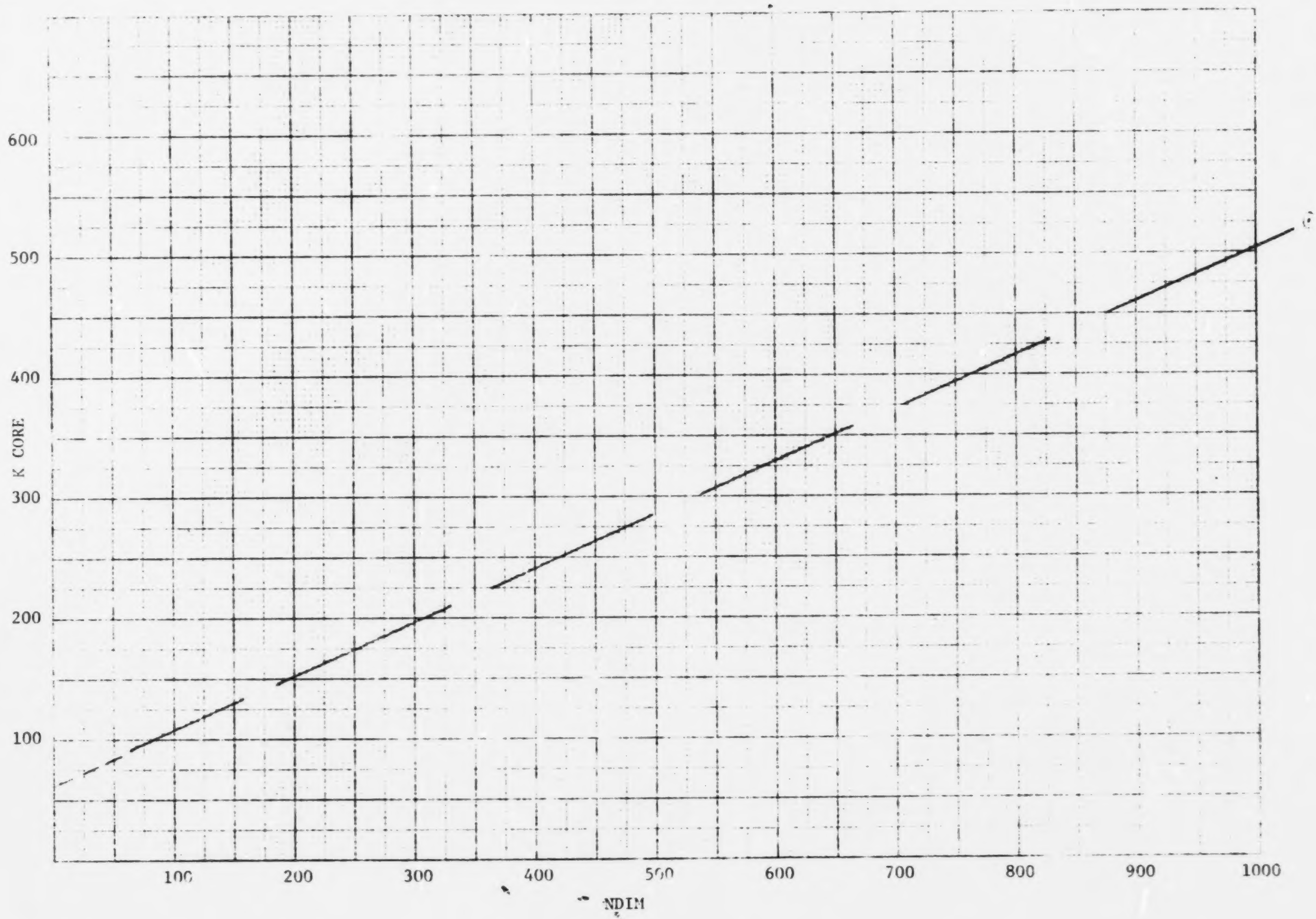


Figure 13. Plot of Core Storage Requirements Vs. the Number of Grid Squares in a County (NDIM)

the state, county, AQCR, and the number of grid squares in the county are read in from cards. Cards with labeling information are then read in and the subroutine READ1, which is described in Section 7.5, is called to read the "fuels" totals for the county from magnetic tape. If READ1 does not return an error condition, processing continues. The weighted apportioning factors are then read from a magnetic tape which was output from the CAASE4 program. The apportioning factor sums are then developed and become the denominators for apportioning each of the source categories. The program iterates ("loops") through the number of grid squares for the county being processed and through all of the "fuel" categories. For each fuel category, the number in each grid square is used as the numerator and the sum of all apportioning values, for all grid squares, for that category is used as the denominator. This fractional portion of the total "fuel" within the county is later apportioned to the grid square. For example, if there are 50 grid squares within the county being processed, the first fuel category (residential fuel-anthracite coal) is apportioned into the 50 grid squares based on the fractional apportioning value assigned to each grid square as explained in Sections 1.3, 5.1, and 9.0. A summation of these fractions, for all grid squares, for each category, yields unity, i.e., summing all of the numbers for each grid square within the county for "Fuel Category 1" will equal the first denominator. After the fuels have been apportioned for all categories, the subroutine OUTPT1 is called which causes the printing of tables; OUTPT1 is described in Section 7.6. The CAASE5 program then calculates total emissions for each of the five pollutants of interest (SP, SO_2, NO_x, HC, and CO) for each of the fuel categories. The mobile source categories are dealt with in the same way that the EPA NEO3 program calculates them — measured vehicle miles by speed categories are used, if available, and the ratios for vehicle classes are calculated using estimates of miles per gallon of fuel used for each of the different vehicle classes. The emissions are then apportioned one pollutant at a time to limit the core storage requirements. The total emissions for all fuel categories, for the county, is summed and printed for comparison with the total emissions recorded on the NEDS USER'S file. The five emissions for all fuel categories are summed for each grid square and saved for the IPP cards which will be output later using the OUTPT3 subroutine described in Section 7.8 of this manual. The apportioned emissions are printed in tabular form using the subroutine OUTPT2 which is described in Section 7.7 of this manual. After apportioned emissions are output for all five pollutants the IPP cards are produced by calling the OUTPT3 subroutine. A binary tape is written containing all table entries. Flow charts of the program logic of CAASE5 and its subroutines appear in Appendix E.

6.2 Job Control Language (JCL) and Deck Setup

An example of the deck setup configuration is illustrated in Figure 2. The JCL cards associated with the example are illustrated in Figure 14. The JCL configuration illustrated assumes the following:

a. The program is in object deck form except for the dimension setting driving program.

b. The punched cards assigning values to the input variables are in the job input stream.

c. Apportioning factor data are on magnetic tape, reel number RED141, output from CAASE4 as file number four.

d. The fuels totals for the county being processed are on magnetic tape, reel number ADC519, and represent a stripped file from the NEDS emissions data base.

e. Output of apportioned emissions and fuels are output on the printer file and are written on magnetic tape, reel number RED143, as file number four.

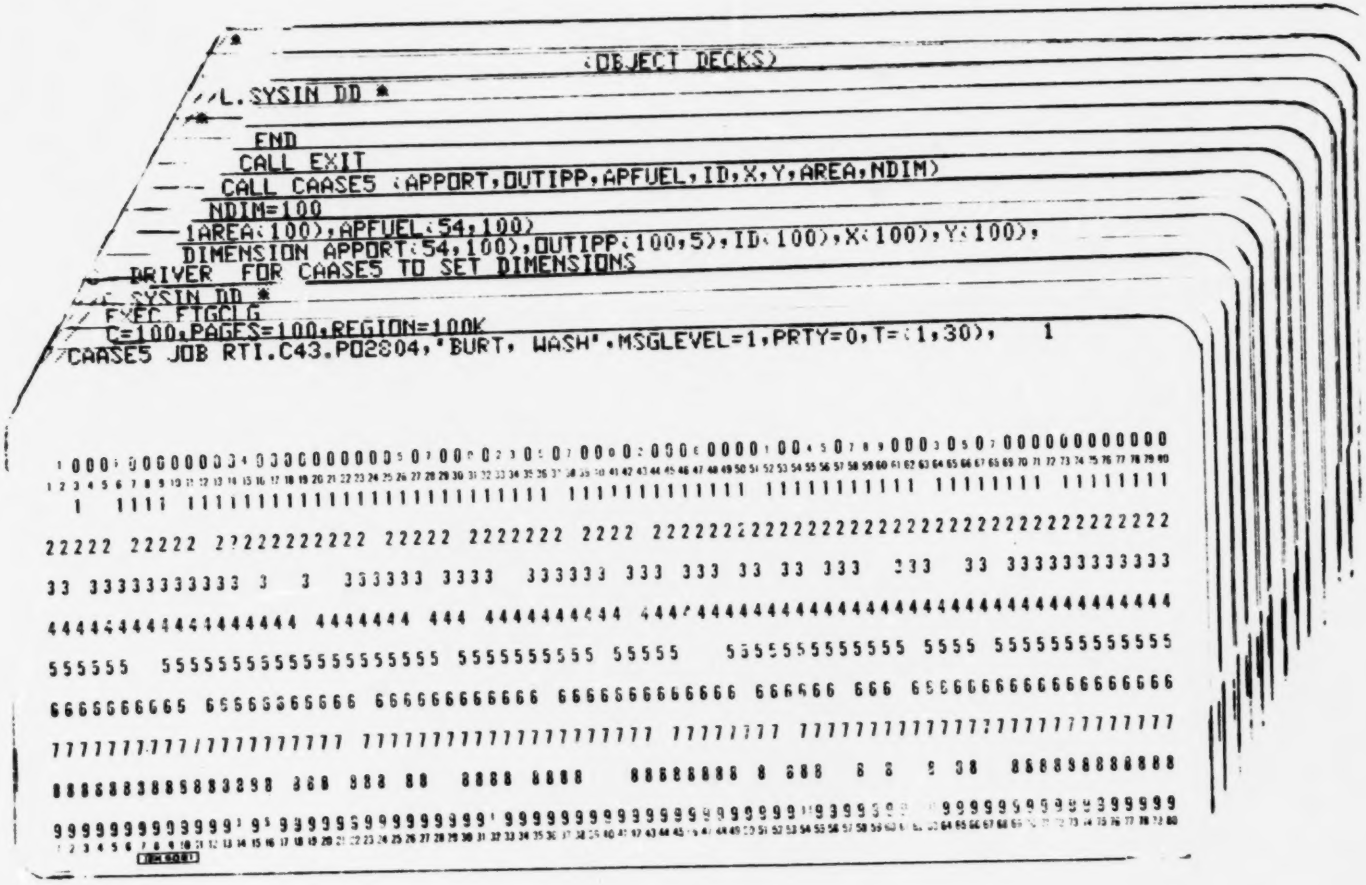
6.3 Input Information

The punched card input variables appear in Table 10. The state, county, and AQCR numbers are input. The number of grid squares for the county being processed, the county name, and the EPA county number are also input. The EPA assignment of county numbers is not the same as the Federal county's assignment on the census tapes; therefore, when referring to the county number, the Federal county code number is used for census data, and the EPA county number is used when searching the "fuels" total tape.

The end of processing for a particular computer run is signaled by a "0" in the input card field specifying the number of grid squares within a county (the variable "NAREAS"). The subroutine READ1 is used for reading the "fuels" totals tape. The grid square identification, the county, the apportioning factor for each grid square-source category combination (a 54 by N array where N is the number of grid squares within the county), the UTM coordinates of the lower left-hand corner of each grid square, and its side length, are input from a binary tape created in CAASE4. The input card layout is described in Table 11.

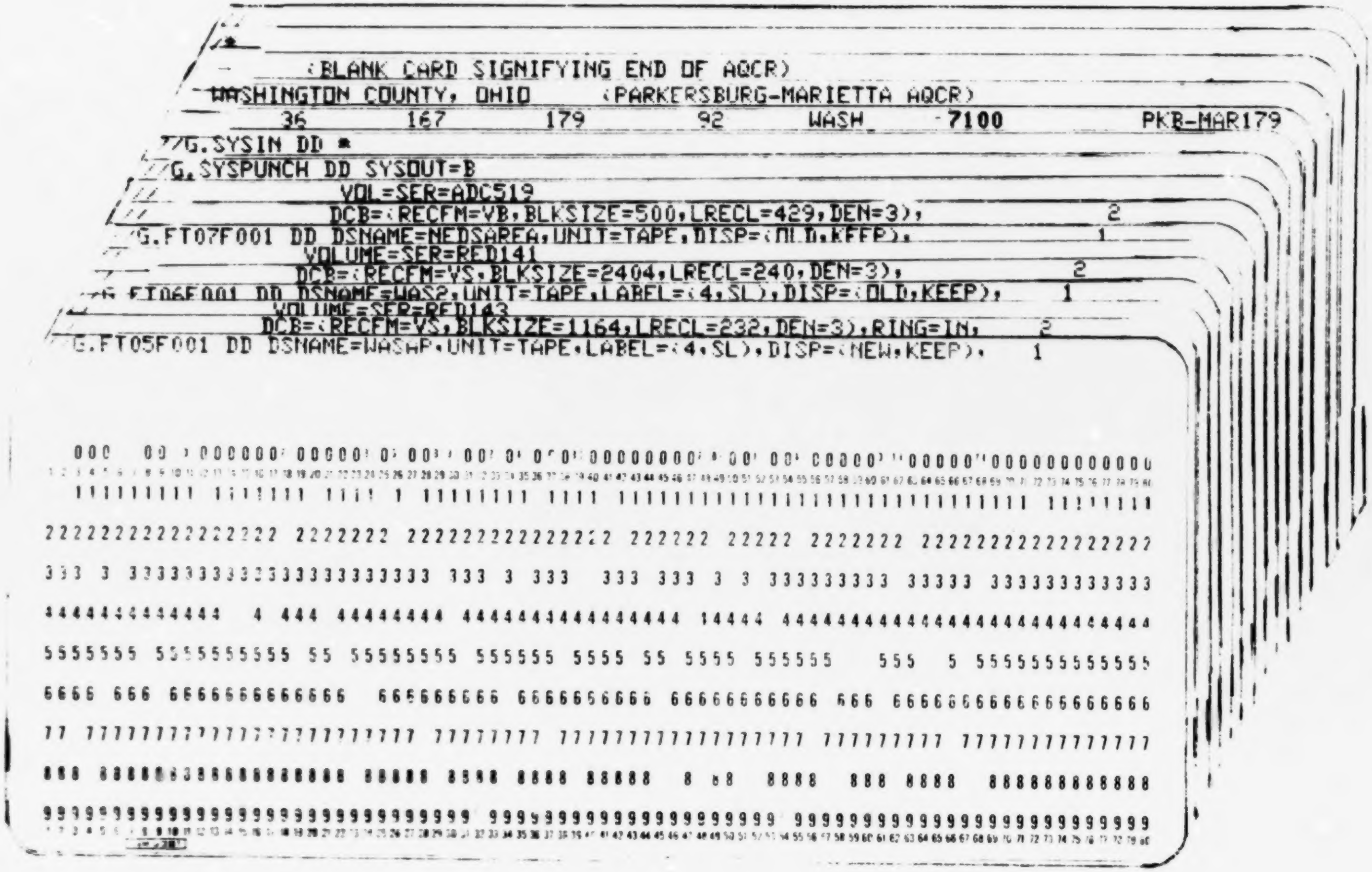
6.4 Output Information

Output from the CAASE5 program includes diagnostic messages, error messages, tables of apportioned fuels, tables of apportioned emissions for each of the five pollutants of interest, an IPP card deck, and a binary tape containing the arrays used in outputting the tables. As explained in Sections 7.6, 7.7, and 7.8 the apportioned emissions and the apportioned fuels are output as tables where OUTPT1 output tables are for apportioned fuels, OUTPT2 tables are apportioned emissions (and separate tables are produced for each of the five pollutants). OUTPT3 also produces the card images in the IPP input format for the five pollutants. A binary tape is produced of the apportioned fuels, emissions, and IPP card variables so that they are available for any additional computer applications which may arise. Figures 15 through 19 are examples of tables of apportioned fuels for Washington County, Ohio; five tables are always necessary to output apportioned fuels for all source categories. Apportioned emissions tables are output in a format similar to the apportioned fuels tables, and Figure 20 is an example of the first page of the first table for particulate emissions for Washington County, Ohio. Figure 21 is an example of the table printed by the CAASE5 program to depict the contribution of each source category to the county total for each pollutant; pollutants numbered 1 through 5 represent SP, SO_2, NO_x, HC, and CO, respectively, and each table is read row-wise for the 54 categories; the last line in the figure appears in the output on a separate page (it was placed in the figure to conserve space) and represents the total particulate emissions for the county for all area source categories and was compared with the total area source emissions from the NEDS USER'S file computed by the EPA NEO3 program during the application of the CAASE system. The county total for each pollutant is output just prior to the output of the apportioned emissions tables for that pollutant. Five tables for apportioned "fuels" are output with a maximum of 45 grid squares on each page, and five tables are output for each of the five pollutants with a maximum of 45 grid squares on each page. Information output on IPP cards is also printed; see Figure 22 for an example.



```
//CAASE5 JOB RTI.C43.PO2804,'BURT, WASH',MSGLEVEL=1,PRTY=0,T=(1,30),    1
   C=100,PAGES=100,REGION=100K
// EXEC FTGCLG
   SYSIN DD *
   DRIVER  FOR CAASE5 TO SET DIMENSIONS
      DIMENSION APPORT(54,100),OUTIPP(100,5),ID(100),X(100),Y(100),
     1AREA(100),APFUEL(54,100)
      NDIM=100
      CALL CAASE5 (APPORT,OUTIPP,APFUEL,ID,X,Y,AREA,NDIM)
      CALL EXIT
      END
/*
//L.SYSIN DD *
                         (OBJECT DECKS)
/*
```

Figure 14. JCL and Input Data Cards for CAASE5



```
//
/*
     (BLANK CARD SIGNIFYING END OF AQCR)
WASHINGTON COUNTY, OHIO     (PARKERSBURG-MARIETTA AQCR)
      36        167        179          92       WASH      7100           PKB-MAR179
//G.SYSIN DD *
//G.SYSPUNCH DD SYSOUT=B
//          VOL=SER=ADC519
//          DCB=(RECFM=VB,BLKSIZE=500,LRECL=429,DEN=3),                  2
G.FT07F001 DD DSNAME=NEDSAREA,UNIT=TAPE,DISP=(OLD,KEEP),                 1
            VOLUME=SER=RED141
            DCB=(RECFM=VS,BLKSIZE=2404,LRECL=240,DEN=3),                 2
G.FT06F001 DD DSNAME=WAS2,UNIT=TAPE,LABEL=(4,SL),DISP=(OLD,KEEP),        1
            VOLUME=SER=RED143
            DCB=(RECFM=VS,BLKSIZE=1164,LRECL=232,DEN=3),RING=IN,         2
G.FT05F001 DD DSNAME=WASHP,UNIT=TAPE,LABEL=(4,SL),DISP=(NEW,KEEP),       1
```

Figure 14. (Continued)

TABLE 10. TABLE OF INPUT VARIABLES, CAASE5

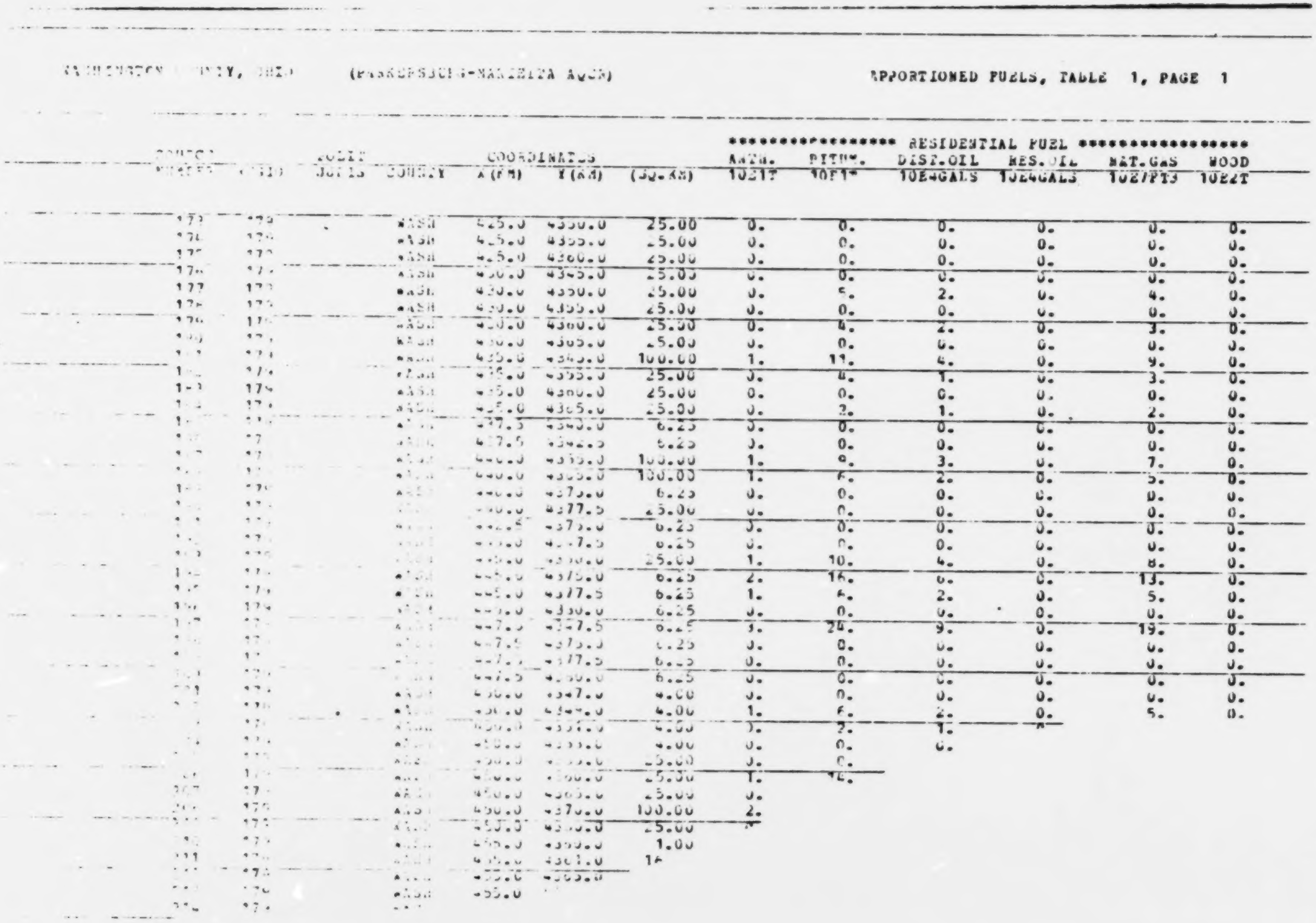
VARIABLE NAME	DEFINITION
XSTATE	EPA state code of selected state
ICNTY	Federal county code of selected county
XAQCR	Code number of selected Air Quality Control Region
NAREAS	Number of grid squares in selected county
CNTY	Name of selected county
KOUNTY	EPA county code of selected county
IPOLIT	Political subdivision of selected Air Quality Control Region
IREGN	Code number of selected Air Quality Control Region
HDG	Page heading including name of county and state of interest

TABLE 11. INPUT CARD LAYOUT, CAASE5

CARD TYPE	COLUMNS	FORMAT	VARIABLE NAME
1*	1-10	F10.0	XSTATE
	11-20	I10	ICNTY
	21-30	F10.0	XAQCR
	31-40	I10	NAREAS
	47-50	A4	CNTY
	51-60	I10	KOUNTY
	70	A1	IPOLIT
	78-80	A3	IREGN
2*	1-80	20A4	HDG
3	A blank card used only when there are no more counties in the AQCR to be processed during the computer run.		

---

*CARD TYPES 1 and 2 make a set which is repeated for each county in the AQCR.



```
[illegible] [illegible]NTY, OHIO     ([illegible])                         APPORTIONED FUELS, TABLE  1, PAGE  1

                                                                   ****************** RESIDENTIAL FUEL ******************
[illegible]             [illegible]            COORDINATES                     ANTH.   BITUM.   DIST.OIL   RES.OIL   NAT.GAS   WOOD
[illegible]  [illegible]  [illegible]  COUNTY  X(KM)   Y(KM)   (SQ.KM)    10E1T   10E1T    10E4GALS   10E4GALS  10E7FT3   10E2T

173  [illegible]   WASH  425.0  4350.0   25.00     0.      0.       0.         0.        0.       0.
174  [illegible]   WASH  425.0  4355.0   25.00     0.      0.       0.         0.        0.       0.
175  [illegible]   WASH  425.0  4360.0   25.00     0.      0.       0.         0.        0.       0.
176  [illegible]   WASH  430.0  4345.0   25.00     0.      0.       0.         0.        0.       0.
177  [illegible]   WASH  430.0  4350.0   25.00     0.      5.       2.         0.        4.       0.
178  [illegible]   WASH  430.0  4355.0   25.00     0.      0.       0.         0.        0.       0.
179  [illegible]   WASH  430.0  4360.0   25.00     0.      4.       2.         0.        3.       0.
[illegible]        WASH  430.0  4365.0   25.00     0.      0.       0.         0.        0.       0.
[illegible]        WASH  435.0  4345.0  100.00     1.     11.       4.         0.        9.       0.
[illegible]        WASH  435.0  4355.0   25.00     0.      4.       1.         0.        3.       0.
[illegible]        WASH  435.0  4360.0   25.00     0.      0.       0.         0.        0.       0.
[illegible]        WASH  435.0  4365.0   25.00     0.      2.       1.         0.        2.       0.
[illegible]             437.5  4340.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]             437.5  4342.5    6.25     0.      0.       0.         0.        0.       0.
[illegible]             440.0  4355.0  100.00     1.      9.       3.         0.        7.       0.
[illegible]             440.0  4365.0  100.00     1.      6.       2.         0.        5.       0.
[illegible]             440.0  4375.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]             440.0  4377.5   25.00     0.      0.       0.         0.        0.       0.
[illegible]             442.5  4375.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]       [illegible]  4377.5    6.25     0.      0.       0.         0.        0.       0.
[illegible]       [illegible] [illegible] 25.00   1.     10.       4.         0.        8.       0.
[illegible]             445.0  4375.0    6.25     2.     16.       6.         0.       13.       0.
[illegible]             445.0  4377.5    6.25     1.      6.       2.         0.        5.       0.
[illegible]             445.0  4380.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]             447.5  4347.5    6.25     3.     24.       9.         0.       19.       0.
[illegible]             447.5  4375.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]             447.5  4377.5    6.25     0.      0.       0.         0.        0.       0.
[illegible]             447.5  4380.0    6.25     0.      0.       0.         0.        0.       0.
[illegible]             450.0  4347.0    4.00     0.      0.       0.         0.        0.       0.
[illegible]             450.0  4349.0    4.00     1.      6.       2.         0.        5.       0.
[illegible]             450.0 [illegible]  4.00   0.      2.       1.
[illegible]       [illegible] [illegible]  4.00   0.      0.       0.
[illegible]       [illegible] [illegible] 25.00   0.      0.
[illegible]       [illegible]  4360.0   25.00     1.  [illegible]
[illegible]             450.0  4365.0   25.00     0.
[illegible]             450.0  4370.0  100.00     2.
[illegible]       [illegible] [illegible] 25.00
[illegible]             455.0  4350.0    1.00
[illegible]             455.0  4361.0   16
[illegible]             455.0  4365.0
[illegible]        WASH  455.0
[illegible]
```

Figure 15. Example of CAASE5 Output Table 1, Apportioned Fuels

```
WASHINGTON COUNTY, OHIO     (PARKERSBURG-MARIETTA AQCR)                               APPORTIONED FUELS, TABLE  2, PAGE  1

                      ****** COMMERCIAL AND INSTITUTIONAL FUEL *******  ********************** INDUSTRIAL FUEL ************************
 SOURCE                ANTH.  BITUM.  DIST.OIL  RES.OIL  NAT.GAS  WOOD   ANTH.  BITUM.  CORE   DIST.OIL  RES.OIL  NAT.GAS  WOOD  PROC.GAS
 NUMBER   COUNTY       10E3T  10E3T   10E3GALS  10E3GALS 10E6FT3  10E3T  10E3T  10E3T  10E3T  10E3GALS  10E3GALS 10E6FT3  10E3T 10E6FT3

  173     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  174     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  175     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  176     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  177     WASH          0.    10.       5.        0.       0.      0.     0.     34.     0.       1.        0.       1.      0.      0.
  178     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  179     WASH          0.     6.       5.        0.       0.      0.     0.     29.     0.       1.        0.       1.      0.      0.
  180     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  181     WASH          0.    24.      14.        0.       1.      0.     0.     85.     0.       2.        0.       2.      0.      0.
  182     WASH          0.     8.       4.        0.       0.      0.     0.     26.     0.       1.        0.       1.      0.      0.
  183     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  184     WASH          0.     5.       3.        0.       0.      0.     0.     19.     0.       0.        0.       0.      0.      0.
  185     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  186     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  187     WASH          0.    14.      11.        0.       1.      0.     0.     68.     0.       1.        0.       1.      0.      0.
  188     WASH          0.    16.       9.        0.       1.      0.     0.     57.     0.       1.        0.       1.      0.      0.
  189     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  190     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  191     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  192     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  193     WASH          0.  [illegible] 12.       0.       1.      0.     0.     78.     0.       2.        0.       2.      0.      0.
  194     WASH          0.    34.      19.        0.       2.      0.     0.    118.     0.       2.        0.       2.      0.      0.
  195     WASH          0.    11.       6.        0.       1.      0.     0.     37.     0.       1.        0.       1.      0.      0.
  196     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  197     WASH          0.    44.      23.        0.       2.      0.     0.    173.     0.       3.        0.       3.      0.      0.
  198     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  199     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  200     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  201     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.       0.      0.      0.
  202     WASH          0.    13.       7.        0.       1.      0.     0.     44.     0.       1.        0.       1.      0.      0.
  203     WASH          0.     4.   [illegible]   0.       0.      0.     0.     15.     0.       0.        0.       0.      0.      0.
  204     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.        0.
  205     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0.       0.
  206     WASH          0.    32.      13.        0.       2.      0.     0.    111.     0.
  207     WASH          0.     0.       0.        0.       0.      0.     0.      0.     0
  208     WASH          0.    27.      15.        0.       1.      0.     0.     95.
  209     WASH          0.     0.       0.        0.       0.      0.     0.
  210     WASH          0.     0.       0.        0.       0.      0.     0.
  211     WASH          0.     0.       0.        0.       0.      0.
  212     WASH          0.    25.      14.        0.       1.      0.
  213     WASH          0.     0.       0.        0.       0.
  214     WASH          0.     0.       0.        0.
  215     WASH          0.     0.       0.
  216     WASH          0
```

Figure 16. Example of CAASE5 Output Table 2, Apportioned Fuels

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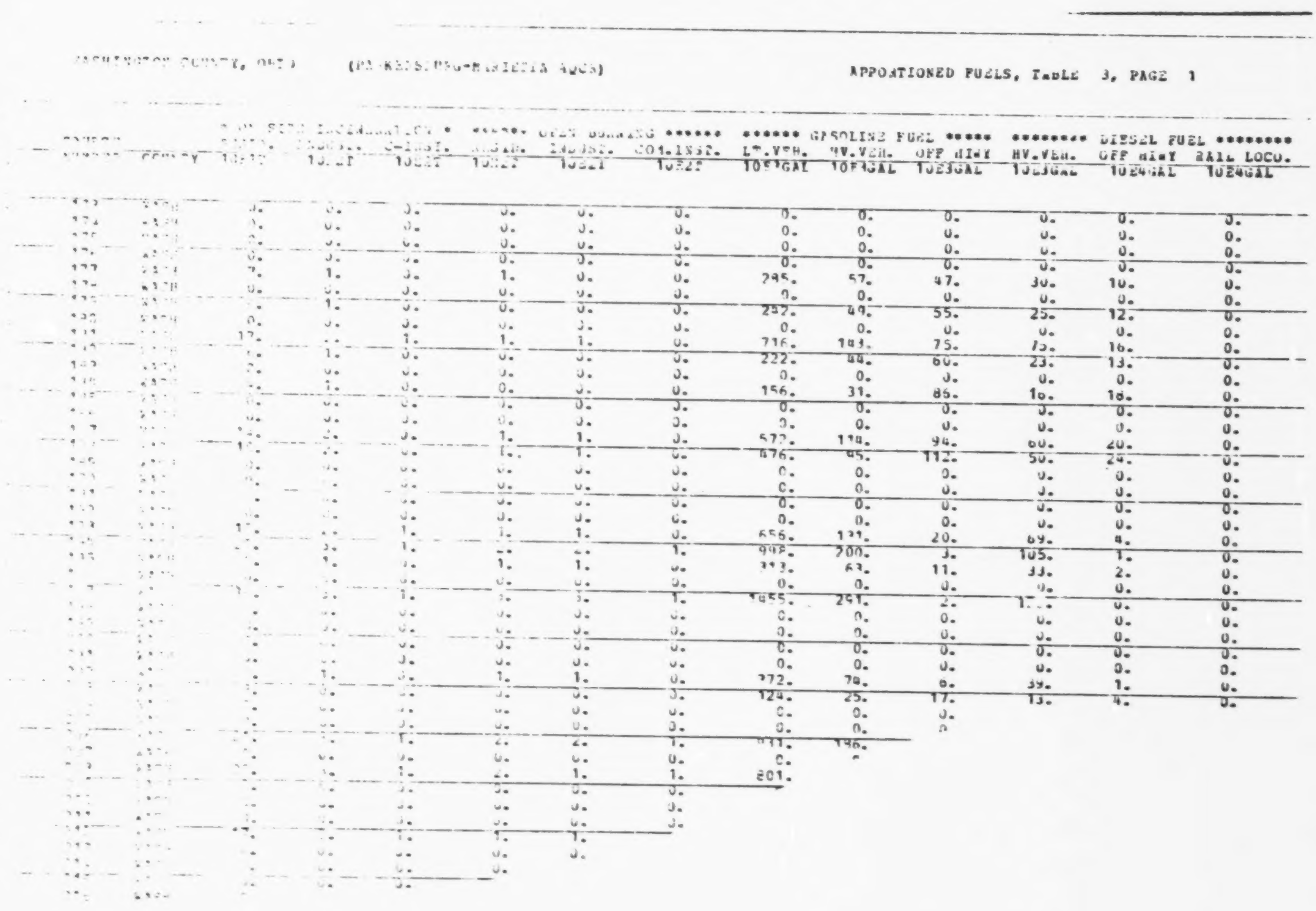
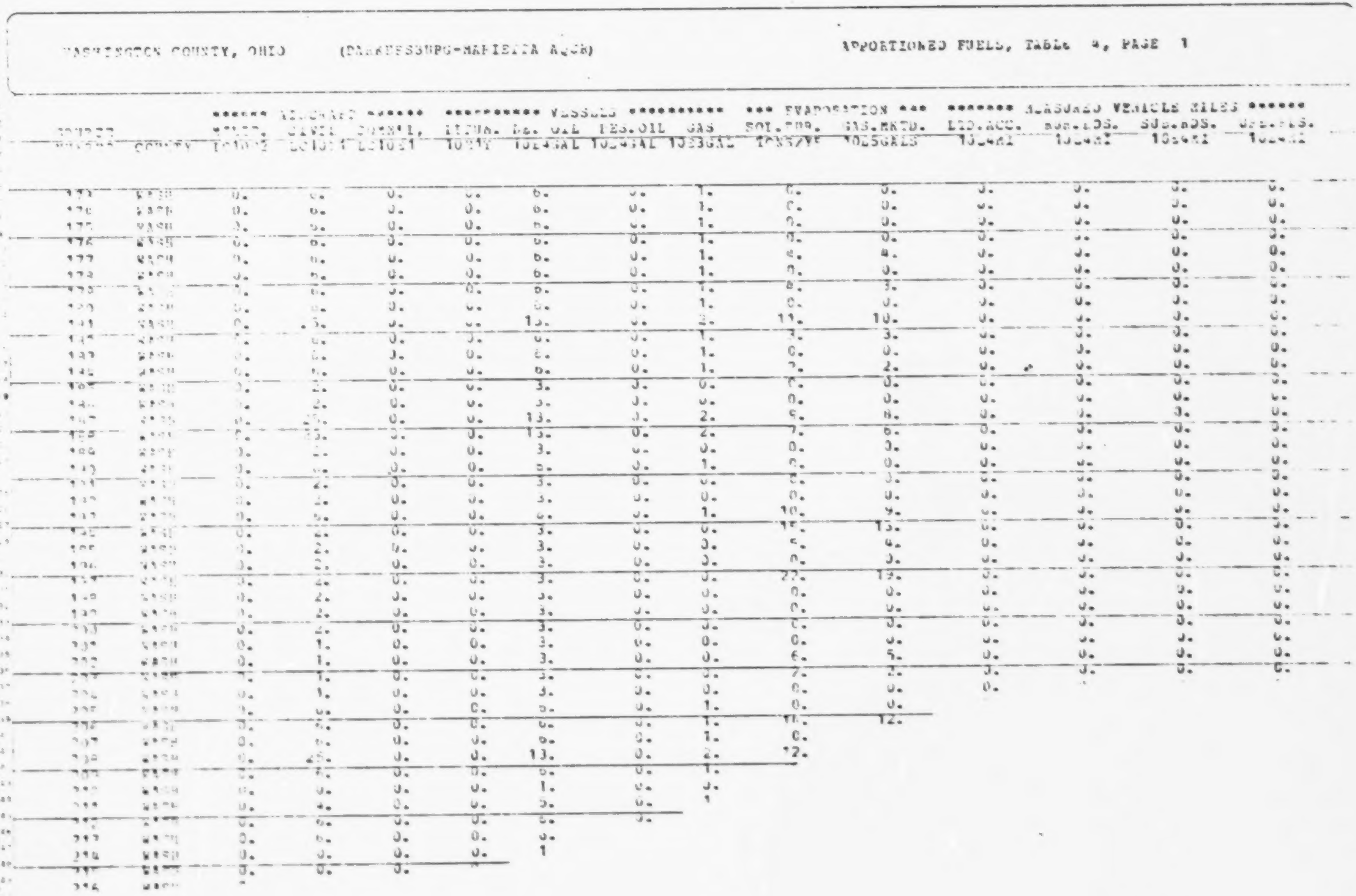
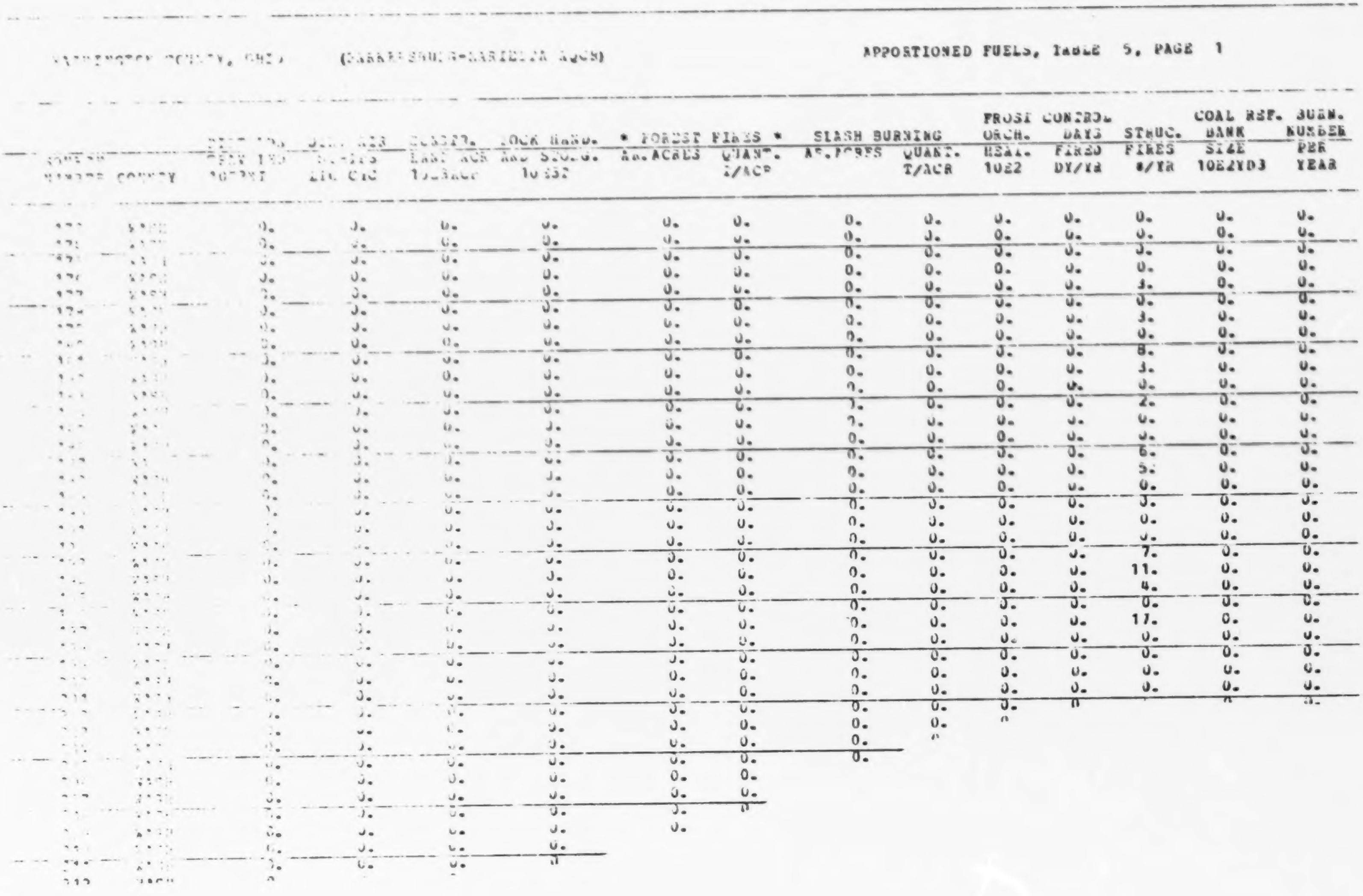




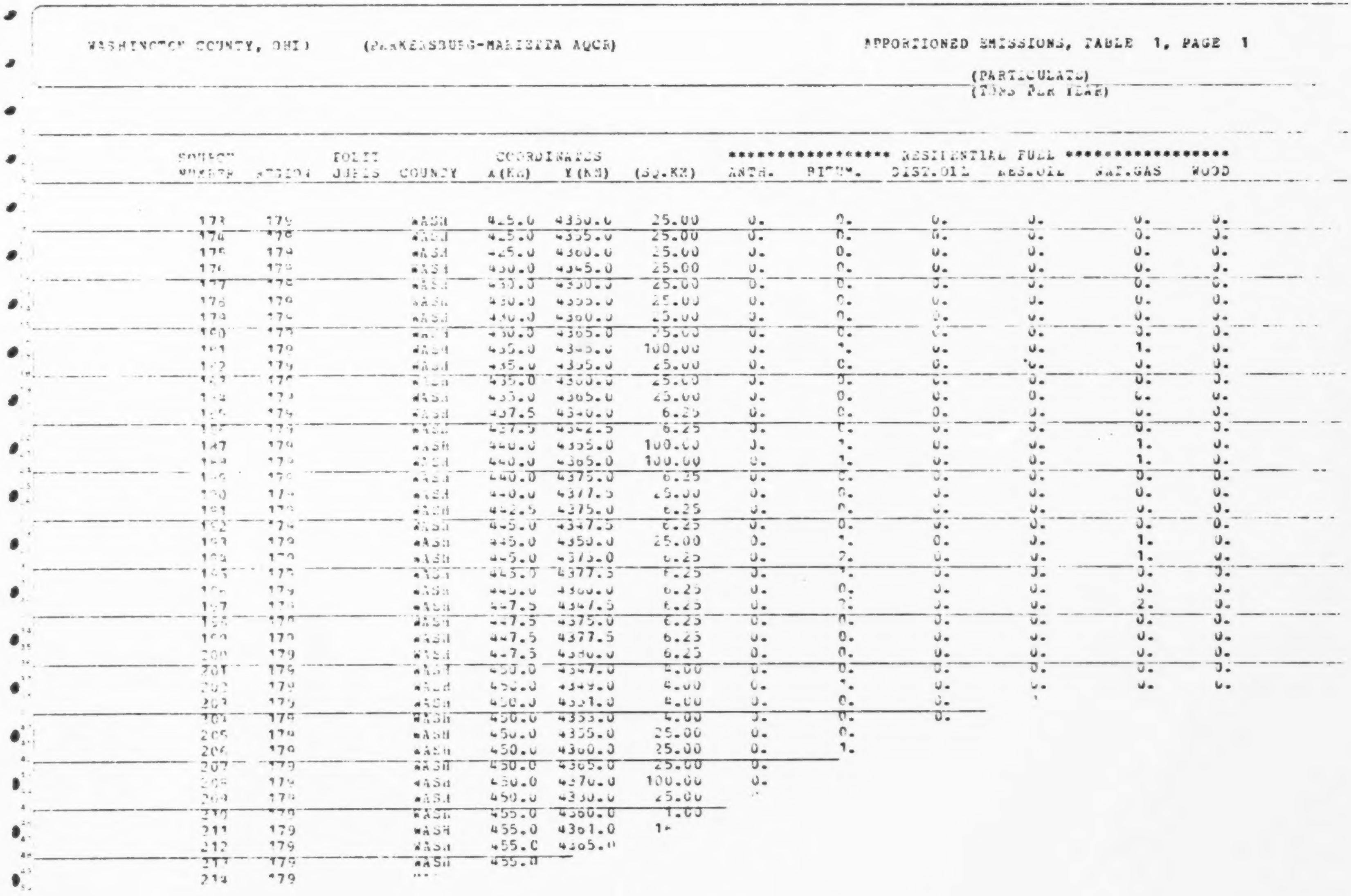
```
WASHINGTON COUNTY, OHIO     (PARKERSBURG-MARIETTA AQCR)                    APPORTIONED FUELS, TABLE  4, PAGE  1

                      ****** AIRCRAFT ******  *********** VESSELS ***********  *** EVAPORATION ***  ******* MEASURED VEHICLE MILES ******
```

Figure 18. Example of CAASE5 Output Table 4, Apportioned Fuels



```
WASHINGTON COUNTY, OHIO      (PARKERSBURG-MARIETTA AQCR)                          APPORTIONED FUELS, TABLE  5, PAGE  1

                                                                                    FROST CONTROL           COAL REF. BURN.
                     [illegible] DIR. AIR  CONSTR. ROCK HAND. * FOREST FIRES *  SLASH BURNING   ORCH.    DAYS   STRUC.  BANK    NUMBER
SOURCE               [illegible] [illegible] LAND ACR AND STOR.G. AR.ACRES QUANT.  AR.ACRES QUANT.  HEAT.   FIRED   FIRES   SIZE     PER
NUMBER  COUNTY       [illegible] [illegible] 10E3ACR  10E3T             I/ACR            T/ACR   10E2    DY/YR   #/YR   10E2YD3   YEAR

[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       3.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       3.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       8.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       3.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       2.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       6.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       5.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       7.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.      11.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       4.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.      17.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.       0.                                   0.
[illegible]       0.       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.       0.
[illegible]       0.       0.       0.       0.
[illegible]       0.       0.       0.
[illegible]
```

Figure 19. Example of CAASE5 Output Table 5, Apportioned Fuels

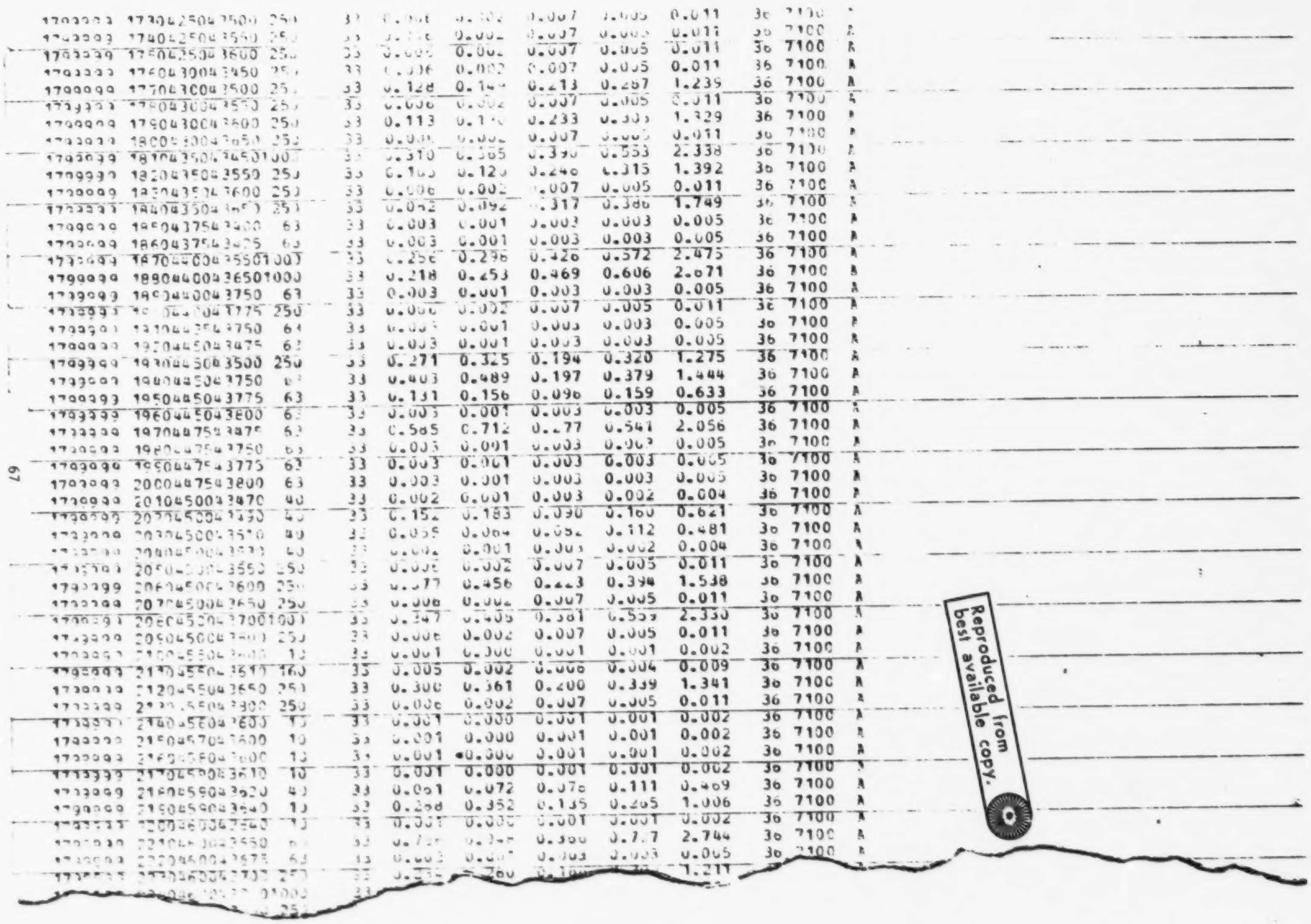


```
WASHINGTON COUNTY, OHIO     (PARKERSBURG-MARIETTA AQCR)                    APPORTIONED EMISSIONS, TABLE  1, PAGE  1
                                                                                     (PARTICULATE)
                                                                                     (TONS PER YEAR)

 SOURCE            POLIT               COORDINATES              ****************** RESIDENTIAL FUEL ******************
 NUMBER   REGION   JURIS   COUNTY    X(KM)    Y(KM)   (SQ.KM)   ANTH.   BITUM.   DIST.OIL   RES.OIL   NAT.GAS   WOOD

   173     179              WASH     425.0   4350.0    25.00     0.       0.       0.         0.        0.       0.
   174     179              WASH     425.0   4355.0    25.00     0.       0.       0.         0.        0.       0.
   175     179              WASH     425.0   4360.0    25.00     0.       0.       0.         0.        0.       0.
   176     179              WASH     430.0   4345.0    25.00     0.       0.       0.         0.        0.       0.
   177     179              WASH     430.0   4350.0    25.00     0.       0.       0.         0.        0.       0.
   178     179              WASH     430.0   4355.0    25.00     0.       0.       0.         0.        0.       0.
   179     179              WASH     430.0   4360.0    25.00     0.       0.       0.         0.        0.       0.
   180     179              WASH     430.0   4365.0    25.00     0.       0.       0.         0.        0.       0.
   181     179              WASH     435.0   4345.0   100.00     0.       1.       0.         0.        1.       0.
   182     179              WASH     435.0   4355.0    25.00     0.       0.       0.         0.        0.       0.
   183     179              WASH     435.0   4360.0    25.00     0.       0.       0.         0.        0.       0.
   184     179              WASH     435.0   4365.0    25.00     0.       0.       0.         0.        0.       0.
   185     179              WASH     437.5   4340.0     6.25     0.       0.       0.         0.        0.       0.
   186     179              WASH     437.5   4342.5     6.25     0.       0.       0.         0.        0.       0.
   187     179              WASH     440.0   4355.0   100.00     0.       1.       0.         0.        1.       0.
   188     179              WASH     440.0   4365.0   100.00     0.       1.       0.         0.        1.       0.
   189     179              WASH     440.0   4375.0     6.25     0.       0.       0.         0.        0.       0.
   190     179              WASH     440.0   4377.5    25.00     0.       0.       0.         0.        0.       0.
   191     179              WASH     442.5   4375.0     6.25     0.       0.       0.         0.        0.       0.
   192     179              WASH     445.0   4347.5     6.25     0.       0.       0.         0.        0.       0.
   193     179              WASH     445.0   4350.0    25.00     0.       1.       0.         0.        1.       0.
   194     179              WASH     445.0   4375.0     6.25     0.       2.       0.         0.        1.       0.
   195     179              WASH     445.0   4377.5     6.25     0.       1.       0.         0.        0.       0.
   196     179              WASH     445.0   4380.0     6.25     0.       0.       0.         0.        0.       0.
   197     179              WASH     447.5   4347.5     6.25     0.       2.       0.         0.        2.       0.
   198     179              WASH     447.5   4375.0     6.25     0.       0.       0.         0.        0.       0.
   199     179              WASH     447.5   4377.5     6.25     0.       0.       0.         0.        0.       0.
   200     179              WASH     447.5   4380.0     6.25     0.       0.       0.         0.        0.       0.
   201     179              WASH     450.0   4347.0     4.00     0.       0.       0.         0.        0.       0.
   202     179              WASH     450.0   4349.0     4.00     0.       1.       0.         0.        0.       0.
   203     179              WASH     450.0   4351.0     4.00     0.       0.       0.
   204     179              WASH     450.0   4353.0     4.00     0.       0.       0.
   205     179              WASH     450.0   4355.0    25.00     0.       0.
   206     179              WASH     450.0   4360.0    25.00     0.       1.
   207     179              WASH     450.0   4365.0    25.00     0.
   208     179              WASH     450.0   4370.0   100.00     0.
   209     179              WASH     450.0   4330.0    25.00
   210     179              WASH     455.0   4360.0     1.00
   211     179              WASH     455.0   4361.0     1
   212     179              WASH     455.0   4365.0
   213     179              WASH     455.0
   214     179
```

Figure 20. Example of CAASE5 Output Table 1, Apportioned Emissions, Particulates

```
TOTALS BY SOURCE CATEGORY FOR POLLUTANT NUMBER     1
    1.440    37.500     3.400     0.0      26.030     3.000     0.0     466.049    23.725     0.0
    7.135     0.0       3.0    2375.183     0.0       3.525     0.0       4.320     0.0       0.0
   73.350    42.000    10.200    31.230    28.900    10.400     0.0       0.0       6.388     0.0
   29.815     0.875     3.0       1.229     0.0       0.0      55.375     0.0       0.240     0.0
    0.0       0.0      63.595     0.0      46.397     0.0       0.0       0.0       0.0       0.0
    0.0       0.0       0.0       0.0

TOTALS BY SOURCE CATEGORY FOR POLLUTANT NUMBER     2
    0.0     230.062     2.038     0.0       0.322     0.100     0.0     573.496    27.193     0.0
    5.335     0.0       0.0    2009.743     0.0       3.337     0.0       0.748     0.0       0.0
    1.272     5.250     1.275     1.750     1.750     0.650     0.0       0.0       4.307     0.0
   59.750     2.275     0.0       0.144     0.0       0.0     143.975     0.0       0.150     0.0
    0.0       0.0      53.540     0.0      35.694     0.0       0.0       0.0       0.0       0.0
    0.0       0.0       0.0       0.0

TOTALS BY SOURCE CATEGORY FOR POLLUTANT NUMBER     3
    0.540     6.025     7.600     0.0      65.500     2.000     0.0      31.556   114.300     0.0
   36.530     0.0       0.0     188.300     0.0      14.100     0.0      43.200     0.0       0.0
    7.535     7.000     1.700    11.700    10.500     3.900     0.0       0.0     153.736     0.0
  495.600     2.675     0.0       1.110     0.0       0.0     166.125     0.0       5.250     0.0
    0.0       0.0    4243.234     0.0     826.823     0.0       0.0       0.0       0.0       0.0
    0.0       0.0       0.0       0.0

TOTALS BY SOURCE CATEGORY FOR POLLUTANT NUMBER     4
    0.370    13.500     1.320     0.0      10.900     0.400     0.0       5.860     5.745     0.0
    1.330     0.0       0.0      12.020     0.0       0.705     0.0       9.600     0.0       0.0
  354.500    15.000     3.500    66.300    59.500    22.100     0.0       0.0     483.045     0.0
   64.560     4.750     0.0       5.643     0.0       0.0     110.750     0.0      16.590   309.000
  242.530     0.0    1857.175     0.0    1369.843     0.0       0.0       0.0       0.0       0.0
    0.0       0.0       0.0       0.0

TOTALS BY SOURCE CATEGORY FOR POLLUTANT NUMBER     5
   11.200   150.750     3.200     0.0      27.400     0.400     0.0      24.696     0.383     0.0
    7.300     0.0       0.0      24.040     0.0       0.047     0.0       0.096     0.0       0.0
  763.500    70.000    17.000   165.750   143.750    55.250     0.0       0.0    2646.704     0.0
  423.000     2.450     0.0      31.104     0.0       0.0     155.050     0.0      90.900     0.0
    0.0       0.0    4263.655     0.0    6727.479     0.0       0.0       0.0       0.0       0.0
    0.0       0.0       0.0       0.0

FOR POLLUTANT=  SP   TOTAL EMISSIONS=       3756.954
```

Figure 21. Contribution of Each Source Category-Pollutant Combination to the County Total



```
1799999 17304250043500 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 17404250043550 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 17504250043600 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 17604300043450 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 17704300043500 250   33 0.128 0.144 0.213 0.257 1.239   36 7100 A
1799999 17804300043550 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 17904300043600 250   33 0.113 0.140 0.233 0.333 1.329   36 7100 A
1799999 18004300043650 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 181043500434501000   33 0.310 0.365 0.390 0.553 2.338   36 7100 A
1799999 18204350043550 250   33 0.165 0.120 0.240 0.315 1.392   36 7100 A
1799999 18304350043600 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 18404350043650 250   33 0.042 0.092 0.317 0.386 1.749   36 7100 A
1799999 18504375043400  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 18604375043425  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 187044000435501000   33 0.256 0.296 0.426 0.572 2.475   36 7100 A
1799999 189044000436501000   33 0.218 0.253 0.469 0.606 2.071   36 7100 A
1799999 18904400043750  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 19004400043775 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 19104425043750  64   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 19204450043475  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 19304450043500 250   33 0.271 0.325 0.194 0.320 1.275   36 7100 A
1799999 19404450043750  63   33 0.403 0.489 0.197 0.379 1.444   36 7100 A
1799999 19504450043775  63   33 0.131 0.156 0.096 0.159 0.633   36 7100 A
1799999 19604450043800  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 19704475043475  63   33 0.585 0.712 0.477 0.541 2.056   36 7100 A
1799999 19804475043750  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 19904475043775  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 20004475043800  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 20104500043470  40   33 0.002 0.001 0.003 0.002 0.004   36 7100 A
1799999 20204500043490  40   33 0.152 0.183 0.090 0.160 0.621   36 7100 A
1799999 20304500043510  40   33 0.055 0.064 0.052 0.112 0.481   36 7100 A
1799999 20404500043530  40   33 0.002 0.001 0.003 0.002 0.004   36 7100 A
1799999 20504500043550 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 20604500043600 250   33 0.377 0.456 0.223 0.394 1.538   36 7100 A
1799999 20704500043650 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 208045000437001000   33 0.347 0.405 0.381 0.559 2.330   36 7100 A
1799999 20904500043800 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 21004550043600  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 21104550043610 160   33 0.005 0.002 0.006 0.004 0.009   36 7100 A
1799999 21204550043650 250   33 0.300 0.361 0.200 0.339 1.341   36 7100 A
1799999 21304550043800 250   33 0.006 0.002 0.007 0.005 0.011   36 7100 A
1799999 21404560043600  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 21504570043600  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 21604580043600  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 21704590043610  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 21804590043620  40   33 0.061 0.072 0.076 0.111 0.469   36 7100 A
1799999 21904590043640  10   33 0.268 0.352 0.135 0.265 1.006   36 7100 A
1799999 22004600043560  10   33 0.001 0.000 0.001 0.001 0.002   36 7100 A
1799999 22104600043550  63   33 [illegible] [illegible] 0.360 [illegible] 2.744   36 7100 A
1799999 22204600043575  63   33 0.003 0.001 0.003 0.003 0.005   36 7100 A
1799999 22304600043700 250   33 [illegible] [illegible] [illegible] [illegible] 1.211
[illegible] 1000   33
[illegible] 250
```

Figure 22. Example of CAASED IPP Card Output

7.0 SUBROUTINE DESCRIPTIONS

7.1 CED009 Subroutine

7.1.1 Subroutine Description

The CED009 routine is used for the conversion of coordinates expressed in latitude and longitude to Universal Transverse Mercator (UTM) coordinates and was obtained from the Mathematics and Computation Laboratory, National Resource Evaluation Center; it is described in NREC Technical Manual No. 187, dated July 1966. The program will convert coordinates worldwide. CED009, as originally received, used five spheroid models which were (1) International; (2) Clarke, 1866; (3) Clarke, 1880; (4) Everest; and (5) Bessel. Tables of coefficients necessary for the conversion equations are contained in a FORTRAN BLOCK DATA Subroutine. In order to conserve computer core storage requirements, and because the standard spheroid used in the United States for dispersion modeling is the Clarke 1866, the routine has been modified to deal only with the Clarke 1866 spheroid. The BLOCK DATA Subroutine was modified to remove all tables of coefficients which were not related to the Clarke 1866 spheroid. The routine will convert geodetic latitudes from 80° south of the Equator to 80° north of the Equator, with those south of the Equator being considered negative. The routine will convert any longitude from 180° west to 180° east of Greenwich, with those west of Greenwich being considered negative; therefore, the CAASE calling program, CAASE1, sets the longitudes from the MED-X census data tapes to a negative value because all of the AQCR's lying within the contiguous United States have west longitudes. Input variables to this subroutine are communicated through the arguments in the "calling list" except for the tables of coefficients which are communicated through FORTRAN labeled COMMON and are set in the BLOCK DATA Subroutine. All output is through the subroutine "call argument list." The routine, as received was coded in FORTRAN for the Control Data CDC 3600 as single precision; however, because the CDC 3600 uses a computer word containing 60 binary bits and because the routine was to be run on an IBM 370/165 system, where a single precision FORTRAN word contains 32 binary bits, all calculations involving numbers with more than six significant decimal digits were modified to use double precision, thereby yielding a FORTRAN word of 64 binary bits. The coefficients for the conversion equations in the BLOCK DATA Subroutine were also converted to double precision for the IBM 370 version. CED009 permits the entry of the geodetic location in radians or seconds with two different scaling factors for each. For consistency, the calling program, CAASE1, calls CED009 with latitude and longitude in seconds scaled by 10^5.

7.1.2 Inputs to Subroutine

Inputs through the "call argument list" include longitude, latitude, and an indicator of longitude and latitude units. Latitudes are expressed as positive north of the Equator and longitudes are expressed as negative west of Greenwich and east of 180° longitude.

7.1.3 Outputs from Subroutine

All outputs from the subroutine are passed through the "call argument list" and include an integer UTM zone number from 1 to 60 corresponding directly to successive 6° intervals of longitude moving eastward from 180° longitude. The UTM parameters for "northing" and for "easting," in meters, corresponding to the 500,000 meters values assigned to the Central Meridian of each zone, are returned to the calling program. An error condition indication is returned to the calling program where a value of 0 denotes "no error" and values of 1 or 2 represent errors in the range of latitude or longitude; 3 indicates an error in units.

7.1.4 Other Subroutines Used

A BLOCK DATA Subroutine is used to initialize the variables in the FORTRAN labeled COMMON "CORD," which are in FORTRAN DOUBLE PRECISION, and are a table of coefficients used in the equations to convert from coordinates expressed as latitude and longitude to UTM coordinates. It contains the FORTRAN statements: EQUIVALENCE, DATA, DOUBLE PRECISION, and COMMON.

7.2 GTGR Subroutine

7.2.1 Subroutine Description

This grid to grid conversion routine, obtained from EPA, is used when an Air Quality Control Region (AQCR) straddles a UTM zone boundary. It is necessary, in order to construct a grid made up of contiguous squares of unequal size, for a common origin to be established for the entire AQCR; that is, to establish a lower left-hand corner for the entire grid, then to relate all grid squares for the AQCR to this common origin. The mathematical formulae to convert coordinates from one UTM zone to another are those contained in the Department of the Army Technical Manual TM-5-241-8, entitled "Universal Transverse Mercator Grid" (July 1958), Chapter 5, Section 31. Tables used in the GTGR subroutine are from the Department of the Army Technical Manual TM 5-241-2. Calculations are carried out in FORTRAN DOUBLE PRECISION arithmetic and the tables for making the conversion are in a FORTRAN DEFINE FILE statement and reside on disk; only a portion of the tables are read in to central core, depending on where the point to be converted is geographically located. The subroutine permits the grid to grid conversion from east to west, or from west to east; that is, one can express the coordinates in the eastern zone as points relative to the western zone, or conversely, can express the points in the western zone as coordinates relative to the eastern zone. The CAASE system will permit either UTM zone to be declared the "primary zone" but the user is cautioned that when selecting the eastern zone as the primary zone it is possible to generate negative east-west UTM coordinates which, at this time, are unacceptable to the Implementation Planning Program (IPP). For the CAASE applications thus far, the western zone has been declared the "primary" zone with one exception. However, because a distortion error is introduced when converting from one zone to another, and is directly proportional to the distance the point is located outside of the primary zone, the user should be aware that if most of an AQCR lies in the eastern zone, but if a small portion of it extends into the western zone, less distortion will be introduced by making the eastern zone the "primary" zone. The introduction of negative easting coordinates must still be avoided.

7.2.2 Inputs to Subroutine

All inputs to subroutine GTGR are passed through the "call argument list," or read from a disk file. Inputs through the "call argument list" are the UTM "northing" coordinate, the UTM "easting" coordinate, and a variable indicating whether to convert east-to-west or west-to-east. The input UTM coordinates are modified and therefore are changed from their input values.

7.2.3 Outputs from Subroutine

All outputs from subroutine CTGR are passed to the calling program through the "call argument list" and are modified input values for the "easting" and "northing" UTM coordinates, and represent their position relative to the new (primary) zone. An error flag is set if the point to be converted lies outside the range of the tables.

7.2.4 Other Subroutines Used

No non-systems routines are used.

7.3 POPMAP Subroutine

7.3.1 Subroutine Description

POPMAP is a population map plotting routine and is called by CAASE2 to draw a map depicting centers of population and their relative population. The routine "opens" (starts) a plotter picture of the specified size, draws X and Y axes, places tick-marks along these axes, and labels the map, in addition to plotting the population data. Using scaling factors passed to the subroutine through a FORTRAN COMMON statement, a map of any practical scale can be produced. For the CAASE applications thus far, a scale of 1:250,000 has been used. For demonstrational purposes, other scales were tested. The first POPMAP subroutine call for each county causes the axes and labeling information to be produced. For each call to the routine, a triangle (it could be any of several symbols) is plotted at the center of the enumeration district, and a circle is drawn around it with its radius proportional to the population of the enumeration district. The scale used in this application was 1 inch of radius for each 4,000 people. Subroutine CIRCLE is described in Section 7.9.

7.3.2 Inputs to Subroutine

All inputs are through the FORTRAN labeled COMMON "SCALES." The inputs include the name of the state, the name of the county, the UTM coordinates of the lower left-hand corner of the county, the scale factor for the radius of each circle, the value of the scale factor for the map, the UTM coordinates of the point to be plotted, the population to be depicted at the point, the length of the X and Y axes in inches, the FORTRAN I/O unit number for the printer, the number of X and Y tick-marks wanted on the axes, and the incremental distance in inches between tick-marks. Also, an indicator is passed denoting whether it is the first call to the routine for that county; that is, must the map axes and labels be drawn. An input variable also determines whether the standard sized picture (a Y axis of 10.5 inches and an X axis of 14.0 inches) can be used. The "default" paper size on the CALCOMP plotter used in this application was 11 inches wide. Therefore, if the standard picture did not provide sufficient space there were two options: (1) that a 10.5 inch Y axis was sufficient, but that the X axis length must be increased (which did not require operator action), and (2) that the operator needed to change to the 30-inch wide paper on the plotter which made a Y axis up to 29.5 inches possible and in which case an operator message had to be issued by the POPMAP routine. In using the CAASE system and a scale of 1:250,000, most counties could be plotted with a 10.5-inch south-to-north and a 14-inch west-to-east plotter picture. Mixing the requirements for 30-inch and 11-inch wide plotter paper on the same computer run is not recommended.

7.3.3 Outputs from Subroutine

POPMAP outputs a map, drawn to scale, with axes and labeling and with a triangle representing each enumeration district center and a circle with radius proportional to its population. Error and diagnostic messages are output if necessary. As explained above, an operator message is issued when non-standard width plotter paper is needed.

7.3.4 Other Subroutines Used

Subroutines used include systems plotter routines which, although performing standard line-drawing plotter functions, may have modifications and aliases which are unique to the system that CAASE was developed on. The Triangle Universities Computer Center (TUCC), located in the Research Triangle Park, North Carolina, is the computer complex used in the development of CAASE. Plotter routines, their names, the functions they perform, and their "call argument list" requirements are briefly described as follows:

a. PICSIZ -- PICSIZ is used to open a picture on the plotter and has "call list arguments" to specify the dimensions of the picture in inches along the X axis and the Y axis, respectively. A call to the PICSIZ subroutine with the arguments (0.0, 0.0) is necessary to close the plotter file at the end of each computer run.

b. PENMSG -- The PENMSG subroutine is used to generate, on the plotter file, a computer console message to the operator at the plotter terminal. Its use in this system has been to inform the operator to place 30-inch wide paper on the plotter.

c. ORIGIN -- The ORIGIN routine is used to redefine the origin in plotter space, and is commonly used when moving the origin from the lower left-hand corner of the "picture" to an internal point to draw axes and tic-marks, etc. ORIGIN can either be progressive, i.e. cumulative, or the new origin can be relative to the corner of the total picture, which has been the application used in the CAASE system.

d. PLOT -- The PLOT program moves the plotter pen from one location within the plotter picture to another location and does it in one of the following ways: with the pen up, or with the pen down. The "call list arguments" of PLOT are an X coordinate or an array of X coordinates, followed by a Y coordinate or an array of Y coordinates, followed by an indicator to either move to the location with the pen up (if the third argument has the value 1), or denotes the size of the arrays if the third argument is greater than 1. The coordinates are expressed as floating point numbers, and represent inches in plotter space. For example, if the pen was at the origin, i.e the picture had just been opened, and the pen was to be moved to the location 4.0 in the X direction and 5.0 in the Y direction in an up position, the subroutine call would be "CALL PLOT (4.0, 5.0, 1)." However, if a line from the origin to 4.0 in X and 5.0 in Y was desired, arrays for X and Y are necessary, where X(1) = 0.0, X(2) = 4.0, Y(1) = 0.0, Y(2) = 5.0, N = 2, the call then is "CALL PLOT (X,Y,N)." Arrays of any reasonable size are possible, the only limitations being available core storage and the required plotting time.

e. SYMBOL -- This routine draws letters or other symbolic characters on the plotting paper. Any character available on an IBM 029 keypunch can be plotted; additionally, many special characters are available (for example, the Greek alphabet). Any character string can be plotted, provided it ends with an "underscore" symbol which is found on the upper case "W" on an IBM 029 keypunch, and also provided the character string is enclosed in quotes.

f. WHERE -- This routine is used to find the current location of the plotter pen, its "call list arguments" return to the calling program the present location of the pen in X and Y coordinates in plotter space inches. It has been used in the CAASE application to insert variable information in labeling a plotter chart after a string of standard characters has been drawn.

g. NUMBER -- This routine's "call list arguments" include an X coordinate, a Y coordinate, a character height expressed in inches, the name of a variable containing a floating point number, the angular displacement in degrees from the X axis, and the number of significant digits desired to the right of the decimal point. It is used to convert a floating point number to EBCDIC characters and to then draw it on the plotter — it uses "SYMBOL" after the conversion.

h. MARK -- This routine is used to plot a special character or symbol with its center at the current pen location. Its "call list arguments" include the symbol number (from a table), and the desired height of the symbol in inches. Its use in CAASE has been to draw a triangle at the center of each enumeration district, and optionally, to draw an "X" at the center of each grid square.

i. CIRCLE -- This routine was obtained from the North Carolina State University Computer Center, and is described in Section 7.9 of this manual.

7.4 POPBOX Subroutine

7.4.1 Subroutine Description

This grid drawing subroutine is called by the CAASE3 program and is used to create the plotter file for drawing a map, to scale, for the entire AQCR, once the grid has been selected off-line using outputs from the CAASE2 program. Communication with the subroutine is through the FORTRAN labeled COMMON "BOXES." The program causes a message to be issued to the operator to replace the standard 11-inch wide plotter paper with 30-inch wide paper. POPBOX is given the coordinates of the lower left-hand corner of each grid square, and its side length and it calculates the other three corners. It then causes a line to be drawn through the five points (the lower left-hand corner being both the starting and ending point). Optionally, an "X" can be drawn at the center of the grid square to aid in error checking. The axes and reference tick-marks are drawn and labeled. A map can be drawn to any scale, the only limitation being the physical size of the available plotter space. In the CAASE applications, thus far, the scale 1:250,000 has been used but, for demonstration purposes, a subset of the grid of an AQCR (ST. LOUIS) was drawn on a scale of 1:24,000. The scale factor is an input variable to the calling routine.

7.4.2 Inputs to Subroutine

All inputs are passed through the FORTRAN labeled COMMON "BOXES," and include the UTM coordinates of the lower left-hand corner of the AQCR, the name of the AQCR, the side length of each grid square, the length of the X and Y axes, the number of tick-marks on each axis (the tick-mark increment spacing has been set for 5 km and is developed by using the scale of the map to calculate the distances in plotter space), the total number of grid squares in the AQCR, and an indicator selecting the option to draw an "X" at the center of each grid square if desired.

7.4.3 Outputs from Subroutine

Outputs from the subroutine include a labeled map, drawn to scale, outlining all grid squares within the Air Quality Control Region being processed, diagnostic messages, and operator messages.

7.4.4 Other Subroutines Used

The plotter systems subroutines PICSIZ, PENMSG, ORIGIN, PLOT, SYMBOL, NUMBER, and WHERE are used, and are briefly described in Section 7.3.4 above.

7.5 READ1 Subroutine

7.5.1 Subroutine Description

This routine reads the "fuel" totals tape for the county being processed. All communication with the routine is through FORTRAN labeled COMMON. A "fuel's total" record from an edited NEDS Area Source file is read for the state, county, and AQCR of interest. The FORTRAN labeled COMMON "WHICH" is used for identification variables, the labeled COMMON "FUELS" is used to pass to the routine the variables read from the "fuels record," and the labeled COMMON "IOUNIT" is used to pass to the routine the I/O unit number assignments. This subroutine is called by the CAASE5 program.

7.5.2 Inputs to Subroutine

Although three FORTRAN labeled COMMON statements are provided, not all of the variables in these labeled COMMON's are used by READ1. The tape I/O unit number, state, county, and AQCR numbers are used. From the "fuels" tape this routine reads all of the variables appearing on the Area Source Form EPA (DUR) 219 3/72. These variables include identification information and "fuels" totals for all of the source categories currently defined.

7.5.3 Outputs from Subroutine

Outputs from this routine are passed through FORTRAN labeled COMMON and include the "fuels total record," an error indication if an "END OF FILE" condition is encountered on the tape without finding the county of interest, and an error message on the printer if the county is not found.

7.5.4 Other Subroutines Used

No non-systems routines are used.

7.6 OUTPT1 Subroutine

7.6.1 Subroutine Description

This routine, called by the CAASE5 program, formats and prints a tabular listing of the apportioned ("SMEARED") county fuel totals for all source categories on Form No. EPA (DUR) 219 3/72. All communication with the calling routine is through FORTRAN labeled COMMON statements. Five tables are produced, and apportioned fuels for up to 45 grid squares are printed on each output page. A binary tape record is written for each grid square.

7.6.2 Inputs to Subroutine

All inputs are through FORTRAN labeled COMMON statements and include the apportioned fuel totals, grid square identifications, labeling information, and I/O unit assignment numbers.

7.6.3 Outputs from Subroutine

Apportioned fuel totals, with identification and labeling information, are printed in tabular form. Five tables are produced and data for up to 45 grid squares are printed on each page. Table 1 contains identification information, apportioned fuels, and the first of six source categories, Table 2 contains abbreviated identification information and apportioned fuels for source categories 7-20, Table 3 contains abbreviated identification information and apportioned fuels for source categories 21-32. Table 4 contains abbreviated identification information and apportioned fuels for source categories 33-45, Table 5 contains abbreviated identification information and apportioned fuels for source categories 46-54. A binary tape record is written for each grid square-source category combination and includes the identification data.

7.6.4 Other Subroutines Used

No non-systems routines are used.

7.7 OUTPT2 Subroutine

7.7.1 Subroutine Description

This routine, called by the CAASE5 program, formats and prints the apportioned emissions for each source category on Form No. EPA (DUR) 219 3/72. It is called by CAASE5 five times during the processing of each county and outputs the apportioned ("SMEARED") emissions for one of the five pollutants each time it is called. The only communication with the routine that is not passed through FORTRAN labeled COMMON is a variable indicating which of the five pollutants the emissions array contains. This variable is also used to control the labeling of the tables. With the exception of formatting and labeling, OUTPT2 is very similar to OUTPT1. The routine is called by the CAASE5 program as each pollutant's emissions are calculated and "SMEARED;" this technique is used so that a larger storage array is not required, i.e. one containing all five pollutants.

7.7.2 Inputs to Subroutine

With but one exception, inputs are through FORTRAN labeled COMMON statements which provide I/O unit assignment numbers, identification information, and an array containing emissions for each source category-grid square combination. A pointer is passed through the "call argument list" to indicate which of the five pollutants the emissions array contains.

7.7.3 Outputs from Subroutine

Tabular listings of emissions, by source category-grid square combinations, are output from this routine. Up to 45 grid squares are printed on each page and, in order to deal with all source categories on Form No. EPA (DUR) 219 3/72, five tables are produced each time the routine is called. The table numbers and the source categories contained therein are the same as those described in Section 7.6.3 (OUTPT1 outputs) but the table entries are apportioned emissions instead of apportioned fuels.

7.7.4 Other Subroutines Used

No non-systems routines are used.

7.8 OUTPT3 Subroutine

7.8.1 Subroutine Description

This routine, called by the CAASE5 program, converts the total emissions apportioned to each grid square, from all source categories, from tons/year to tons/day for each of the five pollutants being processed. The routine outputs a printer line and a punched card in the Implementation Planning Program (IPP) format which was expanded to include additional data as described in Section 7.8.3 below.

7.8.2 Inputs to Subroutine

All communication with the subroutine is through FORTRAN labeled COMMON statements which contain location and labeling information, I/O unit assignment numbers, total sulfur dioxide, suspended particles, oxides of nitrogen, hydrocarbons, and carbon monoxide emissions for each grid square.

7.8.3 Outputs from Subroutine

A card is punched for each grid square in the expanded IPP format for area sources, the card image is printed on the line printer, and the data elements are written on binary tape as a separate record for each grid square.

7.8.4 Other Subroutines Used

No non-systems routines are used.

7.9 CIRCLE Subroutine

7.9.1 Subroutine Description

This routine is used for drawing circles with the plotter and was obtained from the North Carolina State University Computer Center; the exact origin of the routine is unknown. All communications with the routine are through the "call argument list." The routine has been modified to prevent the pen from leaving the plotter picture when working near the edge. CIRCLE is called by the POPMAP routine and is used to draw a circle proportional to the population count with its center at the center of an enumera-district. It is possible for the center of an enumeration district, represented by the coordinates from the edited MED-X census tapes, to be within the plotter picture and yet have a circle developed which would leave the picture, i.e., part of the arc along the circumference of the circle would be outside the picture. To keep this from happening, because it generates error messages from the computer's "operating system," the routine has been modified to test for the condition and the arc of the circle is truncated at the edge of the picture. This procedure still provides the user a graphical representation of the relative population because at least 180° of the arc depicting the radius of the circle would be drawn.

7.9.2 Inputs to Subroutine

All arguments in the call list are input variables. They include the X and Y coordinates of the center of the circle to be drawn, the beginning angular displacement from the positive X axis, the final displacement angle from the X axis, the beginning radius, the ending radius, the maximum plotter distance on the X axis, the maximum plotter distance on the Y axis, and a variable used for controlling the drawing of either solid lines or dashed lines. For the CAASE application, the beginning and ending radius were equal, and the beginning and ending angular displacements from the X axis were 0° and 360°, respectively.

7.9.3 Outputs from Subroutine

The subroutine writes plotter records to draw a circle.

7.9.4 Other Subroutines Used

The subroutine PLOT is used; it is described in Section 7.3.4 of this manual.

8.0 OFF-LINE GRIDDING PROCEDURE

8.1 Objective

The objective of the off-line gridding is to provide a logically determined set of grid squares to which area source emissions can be allocated on the basis of characteristics of the grid square or on the basis of subjectively, or objectively determined weighting factors. Pertinent grid square characteristics are: contained population (or its inverse), area side length, contained housing units, and housing per unit area (or its inverse). These characteristics and the introductory discussion in Section 1.0, above, indicate the dominance of population as a basis for the distribution of area source emissions.

8.2 Required Data

The gridding procedure requires, as a primary input, the plotted charts of population centers graphically showing the location and population of each enumeration district in each county of the subject AQCR. These charts are produced as output from the CAASE2 program, and are scaled to match an appropriate base map which presents topographic features, terrain characteristics, and political boundaries. The U.S. Geological Survey, 1:250,000 scale, maps have been very satisfactory as base maps for the gridding.

8.3 Procedure

While several approaches can be taken in preparing a grid for a multi-county AQCR, the following sequence has proved to be satisfactory. Alternative methods or explanatory information is given as appropriate.

a. Select appropriate Geological Survey 1:250,000 scale maps to cover all counties of the AQCR. Outline each county using a felt-tipped pen of contrasting color (blue has been satisfactory). On the edges of each map where they will adjoin other

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map sections, extend the Universal Transverse Mercator coordinate tick-marks[*] into the map area (to preserve their location when the border is trimmed or unfolded).

b. Orient, align, and join the maps required on a working surface of suitable size.[**] Position maps for convenient use of a drafting machine or continuously parallel ruler. When orientation has been established with regard to the UTM coordinate system, secure the maps against further movement.

c. Using the UTM grid system, draw and label gridlines on each separate map. One horizontal (east-west) and one vertical (north-south) gridline on each map should be sufficient. These gridlines are used to orient the county plots of population centers, and to serve as guides for properly joining adjacent maps. Accordingly, the same UTM coordinate gridline should extend from one map to another. Where an AQCR includes more than one UTM zone, the practice has been established within the CAASE programs of relating all coordinates to the westernmost zone. Thus, the UTM grid system of the western portion of the AQCR is extrapolated with straight lines over the eastern portion of the AQCR; UTM tick-marks on maps of the eastern portion of the AQCR are ignored. An exception to this practice occurs if most of the area of the AQCR lies in the eastern UTM zone and a significantly smaller portion of the AQCR area is in the western UTM zone.

d. Overlay the Geological Survey maps with tracing paper on which the grid square system will be drawn. Fasten down the tracing paper in a manner which will allow county population charts to be inserted and aligned between the maps and the tracing paper. Trace the UTM grid lines constructed under c, above, onto the tracing paper as guides to proper register as work continues.

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[*] Indicated by blue tick-marks at 10,000-meter intervals on the four edges of each U.S. Geological Survey 1:250,000 scale map.

[**] A light-table, preferably with an illuminated area of approximately 3 x 3 feet, is considered essential as a working surface.

e. Using the UTM grid, draw lightly a system of 10 km x 10 km coordinates over the entire AQCR. These will be used as guides to the construction of the detailed grid.

f. Arbitrarily select an initial county and trace its border onto the tracing paper (blue pencil). Insert, orient, and temporarily affix the appropriate county population chart between the map and the tracing paper.

g. Examine the relationship between the 10 km square grid drawn in e, above, and the county boundaries and the population centers. Visualize the 10 km grid displaced 5 km north, 5 km east, or both. Select the actual or visualized grid that will (1) most closely approximate the county boundary and (2) permit the largest number of rural population centers to be located near the center of a 10 km x 10 km grid square. If a displaced grid appears most appropriate for the county, construct it, again lightly in pencil, but retain the original 10 km x 10 km grid.

h. Proceed to draw grid squares, using the 5 km, or 10 km square grid and the 5 km ticks plotted on the margins of the population chart as guides. Grid squares with sides less than 5 km long are constructed by direct measurement from an existing gridline. On the 1:250,000 scale map 4 mm equals 1 km.

Considerable judgement must be exercised in selecting the size grid squares to be used. Topography, urbanization, forestation, transportation systems and similar features depicted on the Geological Survey maps all influence the determination of the grid square system. Some isolated population centers can readily be "framed" by squares with 10, 15, 20, 25, or even 30 km sides, without including other centers in the square. Whenever possible, these large grid squares should be used to keep the number of squares designated as small as possible. This saves both clerical time and computer requirements in later steps in the CAASE system. It is not essential that only one population center be enclosed in a grid square. Two or more population centers can fall into one grid square, provided that the map features (or more direct knowledge of the area being gridded) suggest that population distribution throughout the grid square is relatively uniform.

In gridding urban areas containing many enumeration districts, small size grid squares are used to provide a resolution compatible with the data points available. Small size squares are also used where necessary to provide a close approximation of the county boundary. However, even when the smallest practicable grid square, i.e. 1 km by 1 km, is used, occasional inclusion of population centers from the adjacent county occur, as do exclusion of population centers from the county being gridded. This is not considered serious since only small fractions of a percent of the total county population are involved.

Other occurrences of population centers falling outside the county boundaries occur as a result of errors in the location coordinates assigned to the center. Although these misplaced centers are immediately apparent when the population center chart is placed under the overlay on which the county borders have been traced, determination of the source of error usually is not feasible. If the misplaced center is not far from the county border, and is not superimposed on a population center(s) of the adjacent county the grid system being constructed possibly may be expanded to include the misplaced center. In at least one instance, all centers within a county were obviously displaced — those near the county borders by greater distances than those near the center of the county area. This situation suggested an error in a factor related to distance from the county center and a proportional correction factor was determined and applied to all coordinates. Ad hoc decisions must be made for each location error situation occurring in the plotted population charts since the position coordinates cannot be readily traced to primary source data.

i. When the grid square system for one county has been completed, a contiguous county population chart is selected and the process is repeated. No particular pattern of county selection seems preferable. Gridding of an AQCR can be done with equal facility starting with a central county, or an eastern, western, southern, or northern border county.

Figure 23 is an example of a completed county grid.

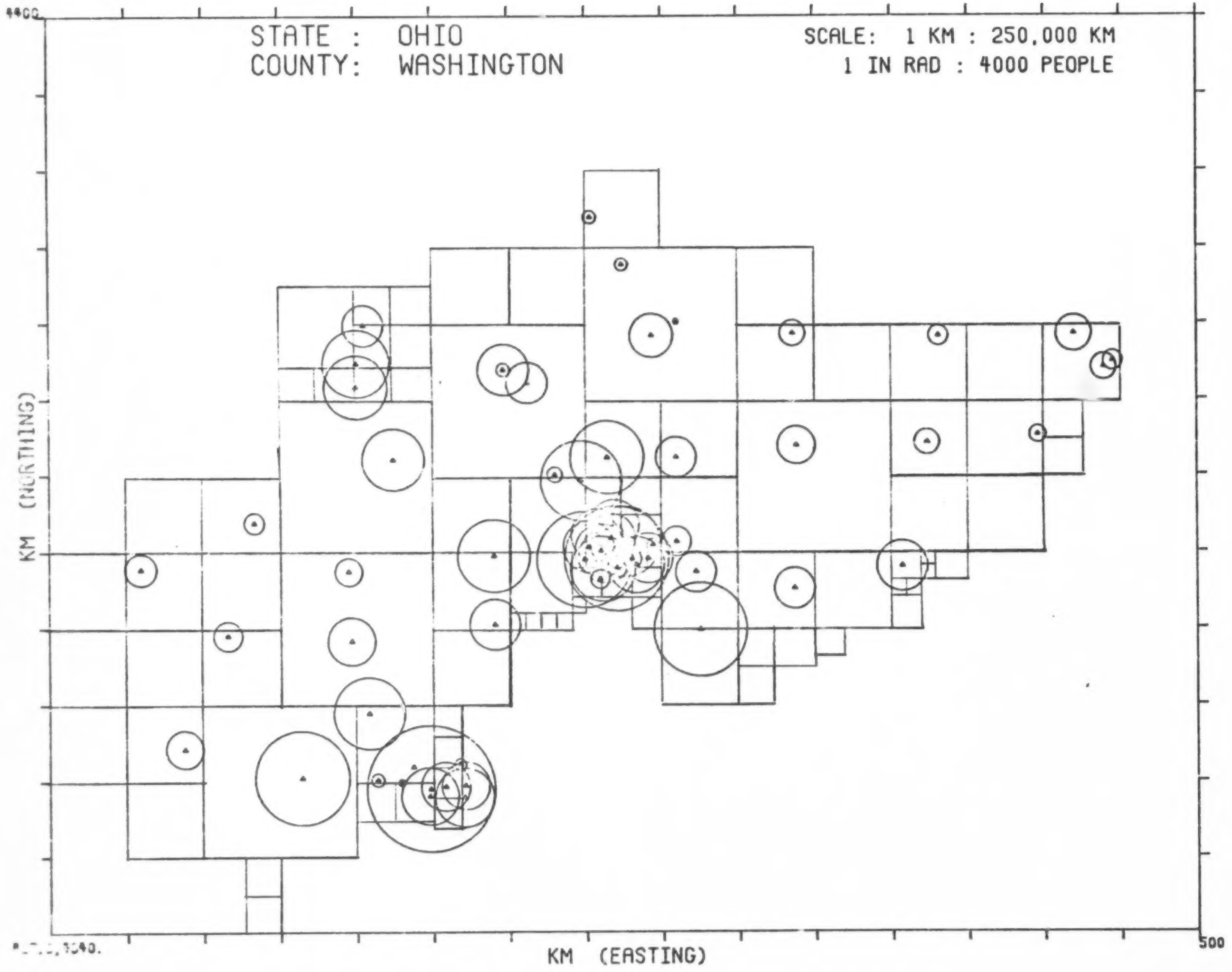
4400
STATE : OHIO
COUNTY: WASHINGTON
SCALE: 1 KM : 250,000 KM
1 IN RAD : 4000 PEOPLE
KM (NORTHING)
KM (EASTING)
500

Figure 23. Example of a Completed County Grid, Washington County, Ohi

9.0 OBJECTIVE APPORTIONING FACTORS AND SUBJECTIVE OVERRIDING WEIGHTING FACTORS

A basic concept in the development of the CAASE procedures was to use objective techniques, where possible, to select a grid and to apportion the area source emissions from county totals for each source category into each grid square. It was recognized that many of the source categories were amenable to apportioning as functions of the distribution of population and housing within counties. Ideally, objective methods could be used throughout the processing of area source emissions using computer processable data sources already available in computer compatible data bases. It was obvious that there were certain categories of usable data available for some counties which were not always available for other counties; further, that much of these data existed only in source document or tabular form, e.g. land use maps, traffic counts, airport operations activity, etc. A great deal of effort would be necessary to assemble these data and to incorporate them into a computer processable data base for objective apportioning. Such an effort, practical or not, was beyond the scope of the project undertaken. It appeared, however, that area source emissions for most categories were amenable to distribution by objective techniques to the grid squares of a county.

For convenience, the several fields of "fuel" data on the Area Source Input Form EPA (DUR) 219 3/72 have been sequentially numbered for category number, major classification, e.g. residential fuel, industrial fuel, etc., and minor classification, e.g. anthracite coal, bituminous coal, distillate oil, etc. Table 12 relates the category number to its major and minor classifications. Although the majority of emission source categories can be apportioned using objective techniques, provisions are made in the CAASE4 program to override any or all source categories for each grid square where available information indicates that the objective apportioning factor will not yield valid results. In order to facilitate the use of any available data for apportioning, the apportioning factor program (CAASE4) logic has been written to optionally input subjectively determined apportioning factors for any area source emissions category on EPA form number 219 (Durham 3/72) for any area source grid

TABLE 12. AREA SOURCE EMISSIONS CATEGORY NUMBERS AND THEIR OBJECTIVE APPORTIONING FACTOR

CATEGORY NUMBER	MAJOR CLASSIFICATION	MINOR CLASSIFICATION	OBJECTIVE APPORTIONING FACTOR*
1	RESIDENTIAL FUEL	ANTH. COAL	HOUSING UNITS
2	RESIDENTIAL FUEL	BITUM. COAL	HOUSING UNITS
3	RESIDENTIAL FUEL	DIST. OIL	HOUSING UNITS
4	RESIDENTIAL FUEL	RESID. OIL	HOUSING UNITS
5	RESIDENTIAL FUEL	NAT. GAS	HOUSING UNITS
6	RESIDENTIAL FUEL	WOOD	HOUSING UNITS
7	COMM'L & INSTITL FUEL	ANTH. COAL	POPULATION
8	COMM'L & INSTITL FUEL	BITUM. COAL	POPULATION
9	COMM'L & INSTITL FUEL	DIST. OIL	POPULATION
10	COMM'L & INSTITL FUEL	RESID. OIL	POPULATION
11	COMM'L & INSTITL FUEL	NAT. GAS	POPULATION
12	COMM'L & INSTITL FUEL	WOOD	POPULATION
13	INDUSTRIAL FUEL	ANTH. COAL	POPULATION
14	INDUSTRIAL FUEL	BITUM. COAL	POPULATION
15	INDUSTRIAL FUEL	COKE	POPULATION
16	INDUSTRIAL FUEL	DIST. OIL	POPULATION
17	INDUSTRIAL FUEL	RESID. OIL	POPULATION
18	INDUSTRIAL FUEL	NAT. GAS	POPULATION
19	INDUSTRIAL FUEL	WOOD	POPULATION
20	INDUSTRIAL FUEL	PROCESS GAS	POPULATION
21	ON-SITE INCINERATION	RESIDENTIAL	HOUSING UNITS
22	ON-SITE INCINERATION	INDUSTRIAL	POPULATION
23	ON-SITE INCINERATION	COMM'L & INSTITL	POPULATION
24	OPEN BURNING	RESIDENTIAL	HOUSING UNITS
25	OPEN BURNING	INDUSTRIAL	POPULATION
26	OPEN BURNING	COMM'L & INSTITL	POPULATION
27	GASOLINE FUEL	LIGHT VEHICLE	POPULATION
28	GASOLINE FUEL	HEAVY VEHICLE	POPULATION
29	GASOLINE FUEL	OFF HIGHWAY	1/POPULATION DENSITY
30	DIESEL FUEL	HEAVY VEHICLE	POPULATION
31	DIESEL FUEL	OFF HIGHWAY	1/POPULATION DENSITY
32	DIESEL FUEL	RAIL LOCOMOTIVE	GRID SQ. SIDE LENGTH
33	AIRCRAFT	MILITARY	AREA
34	AIRCRAFT	CIVIL	AREA
35	AIRCRAFT	COMMERCIAL	AREA
36	VESSELS	ANTH. COAL	GRID SQ. SIDE LENGTH
37	VESSELS	DIESEL OIL	GRID SQ. SIDE LENGTH
38	VESSELS	RESID. OIL	GRID SQ. SIDE LENGTH
39	VESSELS	GASOLINE	GRID SQ. SIDE LENGTH
40	EVAPORATION	SOLVENT PURCHASED	POPULATION
41	EVAPORATION	GAS MARKETED	POPULATION
42	MEASURED VEH MILES	LIMITED ACCESS RDS	1/POPULATION DENSITY
43	MEASURED VEH MILES	RURAL ROADS	1/POPULATION DENSITY
44	MEASURED VEH MILES	SUBURBAN RDS	POPULATION
45	MEASURED VEH MILES	URBAN ROADS	POPULATION
46	DIRT RDS TRAVELED	...	1/POPULATION DENSITY
47	DIRT AIRSTRIPS	...	1/POPULATION DENSITY
48	CONSTRUCT LAND AREA	...	AREA
49	ROCK HANDLG & STORAGE	...	AREA
50	FOREST FIRES	AREA-ACRES	1/POPULATION DENSITY
51	SLASH BURNING	AREA-ACRES	1/POPULATION DENSITY
52	FROST CONTROL	ORCHARD HEATERS	1/POPULATION DENSITY
53	STRUCTURE FIRES	NO./YEAR	POPULATION
54	COAL REFUSE BURNING	SIZE OF BANK	AREA

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*Each of the above apportioning factors is multiplied by a weighting factor [illegible] which are initialized as [illegible] for all grid squares and [illegible] grid squares. These [illegible] weighting factors can be [illegible] desired.

square in the county(ies) being processed. The most extreme use of this option would be to subjectively determine the fraction of the "fuels" for each and every area source emission category, for each and every grid square being processed, and thus override all the objective terms (apportioning factors) in CAASE4; the grid used could even be one developed independently of the CAASE system — CAASE4 would simply perform some calculations for the user and provide compatible inputs to CAASE5 which would then calculate emissions and apportion them with the apportioning factors output from CAASE4.

An attempt has been made to assign an objective apportioning factor to each area source emissions category reported on EPA form number (DUR) 219 3/72. Candidate objective apportioning factors available on the Bureau of the Census MED-X* tapes, include population, housing counts, and an urban-rural classification. After the grid is established, each grid square area and side length is also available. During the attempt to assign objective apportioning factors to all source categories, the conclusion was reached that some categories, e.g. apportioning of the residential heating source categories by housing counts, were quite amenable to objective methods, while others, e.g. airport operations, were not amenable to objective apportioning and should be subjectively determined and "overridden" (provided off-line as inputs) in all cases.

Although the CAASE system permits subjective weighting factors to be assigned for any source category, from a practical standpoint they should be limited to those categories where acceptable objective data, in a computer processable form, are not available. A large number of technical personnel man-hours could be expended to "better" apportion a source category which may contribute only one or two percent of the total area source emissions and as little as one-tenth of one percent of the AQCR's total emissions (when point sources are included). To apportion emissions from airport operations as a function directly proportional to the area of each grid square introduces a small error; however, one can quickly determine which grid squares in a county contain airports, or appear to be affected by them. On the other hand, a large amount of time could be spent in preparing overriding weighting factors for railroad operations in an urban county containing a large number of grid squares and heavy railroad activity (e.g. St. Clair County, Illinois, in the Metropolitan St. Louis AQCR) where an objective apportioning factor may yield comparable results — to apportion railroad activity as a function of grid square size may introduce insignificant and therefore acceptable percentage errors.

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*Master Enumeration District Listing (MEDList) extended to include geographic coordinates.

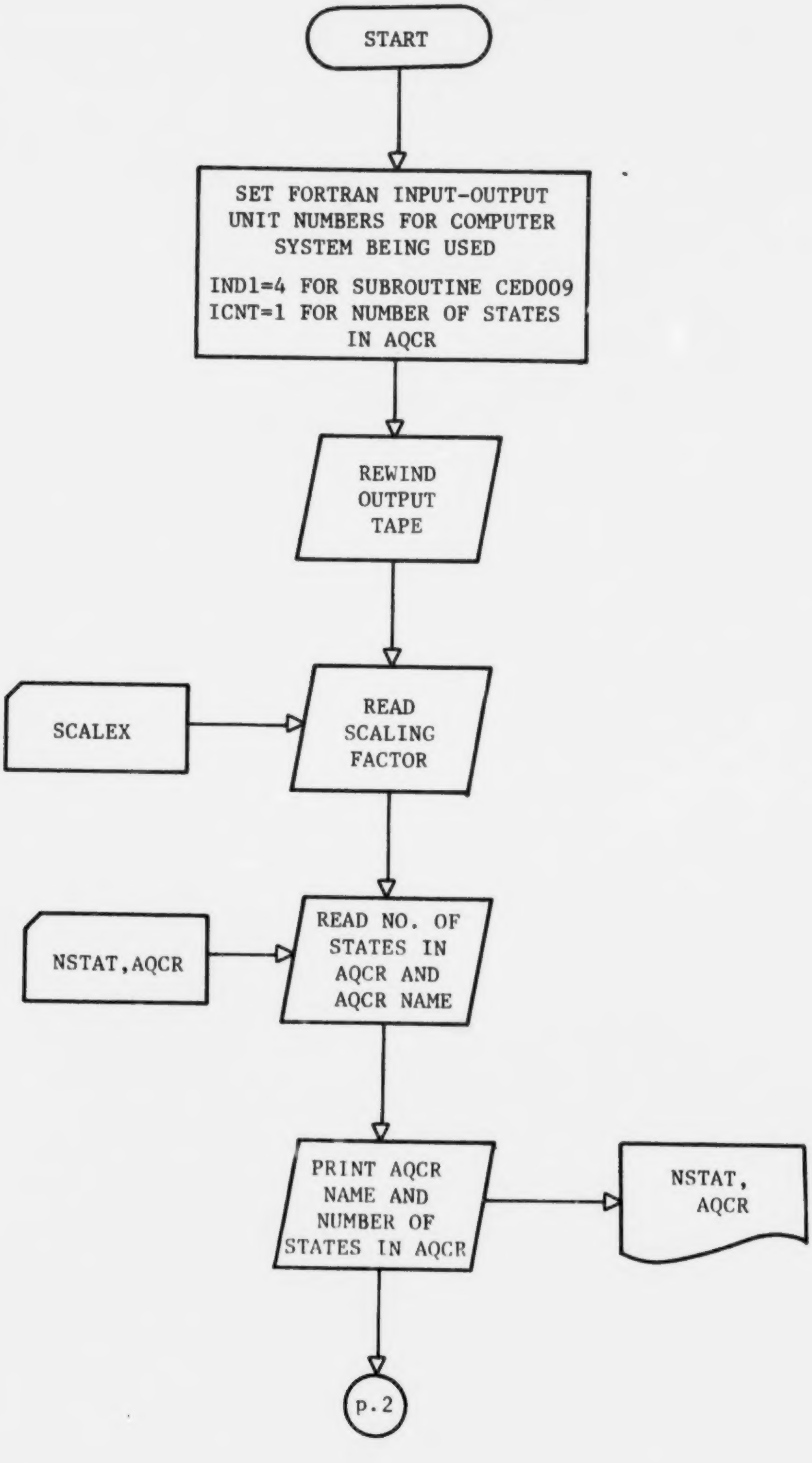
An important point to keep in mind when assigning overriding apportioning factors is that the factor is developed by dividing the weight assigned to the particular grid square (for a particular source category) by the sum of the weights assigned to all grid squares in the county. Therefore, whether the total refers to housing counts, area, population, or a combination of these and/or other factors will in no way modify the total emissions in the county which are to be apportioned to the individual grid squares. For each source category, the apportioning value represents each grid square's proportional share of the county total. This apportioning value is used as a numerator for the fraction of total fuels or total emissions which will be apportioned to that particular grid square for that particular source category. To sum all of the fractions for a particular source emissions category associated with each individual grid square within the county would yield unity. In order to permit the overriding of any source category-grid square combination, the apportioning number which is used is actually the product of a weighting factor and an objective apportioning factor. The weighting factors for most source categories are initially set to 1.0 (others are set to zero) by the CAASE4 program for all grid squares, which essentially removes their effect on the apportioning; that is, apportioning is totally controlled by the objective apportioning factor (value) assigned by the program (e.g. housing units), because each grid square is given the weight of 1.0. However, in the case of airport operations (source category numbers 33, 34, and 35), the weighting factors for all grid squares are initially assigned the value zero. This zero weighting factors assignment means that no emissions associated with aircraft operations will be apportioned to a grid square unless the technical personnel processing the county through the CAASE system assigns a non-zero weighting factor to a grid square(s). For aircraft operations the objective apportioning factor used is area which is then multiplied by the weighting factor (generally zero for most grid squares) to apportion the "fuels" and emissions into the grid squares where, in the user's opinion, aircraft operations contribute to pollution. Therefore, a grid square which has a large area would be apportioned more emissions than a grid square which has a smaller area (but both would have the same emissions per unit area), providing they both had equal weighting factor coefficients. The technical personnel dealing with emissions from aircraft operations could, for example, assign a 1.0 weighting factor to any grid square being affected by aircraft operations and leave the zero weighting factor in all other grid squares; the CAASE4 program would then apportion fuels and emissions strictly as a function of area; that is, a grid square of one square kilometer area would be apportioned only one twenty-fifth (1/25th) of the emissions apportioned to a five-by-five kilometer grid square representing 25 square kilometers. Or, the user could assign a value, e.g., 3.0, to the grid squares nearest an airport, 2.0 to the adjacent grid squares, and 1.0 to the furthermost grid squares being affected by aircraft operations, and leave zeroes in the remaining grid squares. This would cause both the area of the grid squares and their proximity to the airport (and aircraft operations areas) to be determining factors as to where these categories of source emissions should be apportioned within the county. It is possible, of course, to change the initialization value (in the CAASE4 program deck) for source categories 33, 34, and 35, and to simply assign a "default" weighting factor of 1.0. This would have the effect of apportioning the emissions and fuels from aircraft operations equally (emissions per unit area) throughout the county whereby grid squares with large areas would be apportioned proportionally larger portions of the emissions. It would, in effect, be analogous to an additional background concentration factor when used in a dispersion model. It is suggested that emissions from these types of activities be apportioned to grid squares which they affect where information and technical man-hours are available. The method of introducing overriding apportioning weighting factors is discussed in Section 5.3, Input Data — CAASE4.

Source emissions categories, which can be described as linear, i.e. with only length considered, are objectively apportioned as being directly proportional functions of grid square side lengths. Emissions from railroad locomotives and waterborne vessels, especially in non-urban areas, should be apportioned based on the linear variable "grid square side length" rather than the second degree variable, area. Using railroad tracks as an example (with no consideration of the relative traffic activity), if a track(s) spans a grid square then, for source emissions apportioning purposes, the basic consideration is the length of the track(s) lying within the grid square being considered. Any objectively assigned apportioning, or subjectively determined weighting, factor will be used for the later determination of the grid square's fractional contribution to the county total source emissions for railroad locomotive categories. With these goals in mind, the largest distance across a grid square is the diagonal distance through the opposite corners (e.g. northwest corner to southeast corner), and mathematically is the square root of twice the square of the side length, or simply $d = \sqrt{x^2 + y^2}$ where x and y are equal and for which the distance becomes $d = \sqrt{2x^2}$ or $\sqrt{2}\, x$. The constant $\sqrt{2}$ appears for each grid square in any summation for all non-zero apportioned grid squares and can therefore be dropped when weighing each grid square's contribution to the county total. If railroads are to be assigned subjectively determined (or alternative objective) overriding weighting factors when processing a county, then the following approaches are suggested: A scale of zero to ten (or any convenient scale) can be established whereby, for each grid square, the overriding subjectively determined weighting factor is a combination of the number of tracks crossing the grid square and what fraction of the maximum possible distance across the grid square each track represents. A single railroad track crossing the grid square coincident with one of the maximum possible distances could then, for example, be assigned the overriding apportioning factor of 1.0; two parallel tracks crossing there could then be assigned the value 2.0. One track crossing a grid square along a path one-half the distance of the maximum possible distance could be assigned the overriding factor 0.5 and if two tracks were being considered, then they could be assigned twice this value, i.e. 1.0.

As explained in other sections of this manual, a great deal of resolution (sophistication) can be introduced in the assignment of subjectively determined (or alternative objective) overriding weighting factors, but the CAASE system's user should weigh the anticipated benefits in resolution and accuracy versus the gross assumptions of annual averaging of total emissions, meteorological conditions, and the source category's percentage contributions to the total emissions; an unwarranted amount of technical-personnel time could be expended to obtain fractional percentages of change in the total air quality modeling outputs as functions of the apportioned area source inputs.

APPENDIX A

LOGICAL FLOW CHARTS — CAASE1 (and Subroutines)


START
SET FORTRAN INPUT-OUTPUT UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED
IND1=4 FOR SUBROUTINE CED009
ICNT=1 FOR NUMBER OF STATES IN AQCR
REWIND OUTPUT TAPE
SCALEX
READ SCALING FACTOR
NSTAT,AQCR
READ NO. OF STATES IN AQCR AND AQCR NAME
PRINT AQCR NAME AND NUMBER OF STATES IN AQCR
NSTAT, AQCR
p.2

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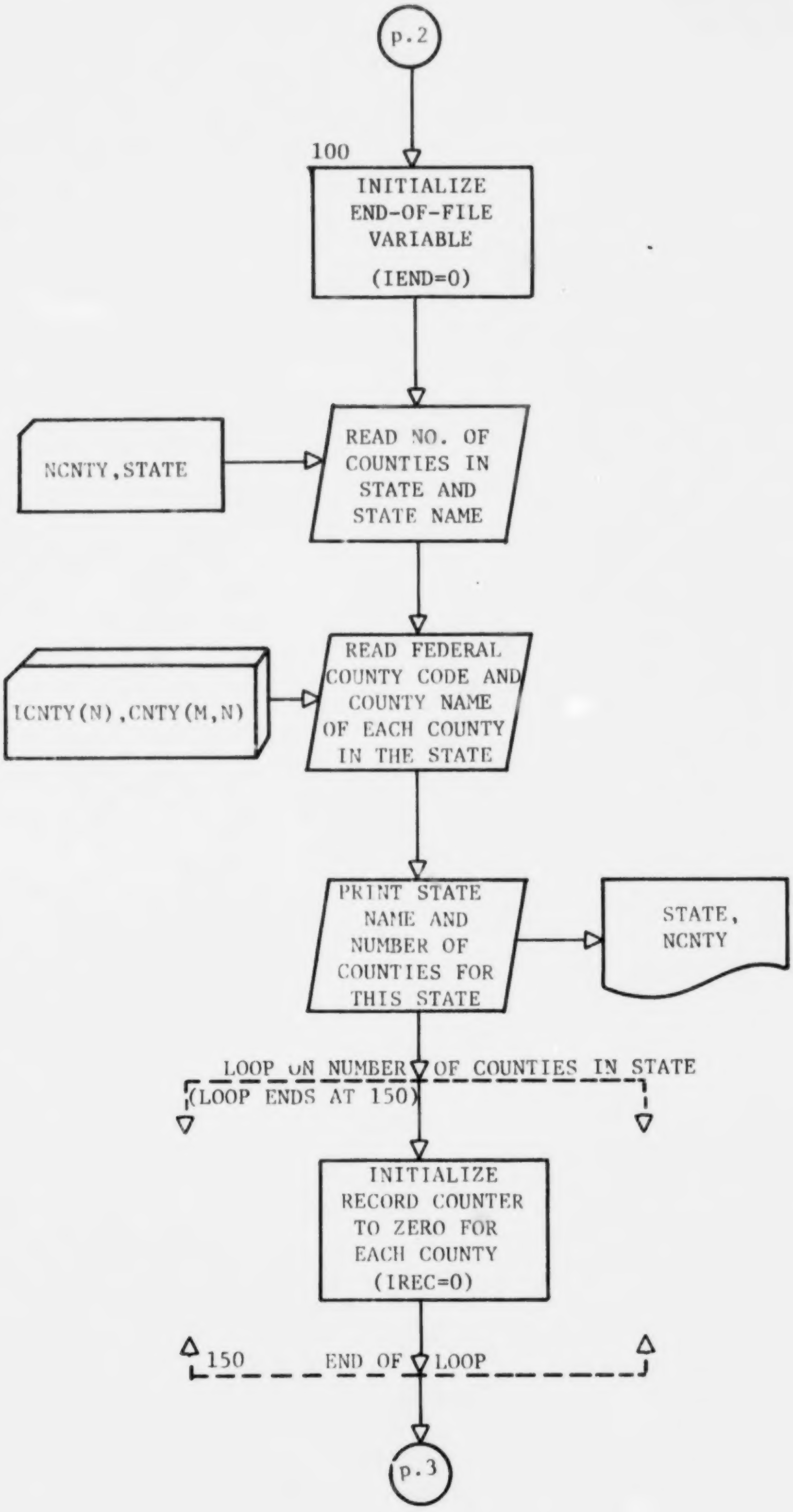
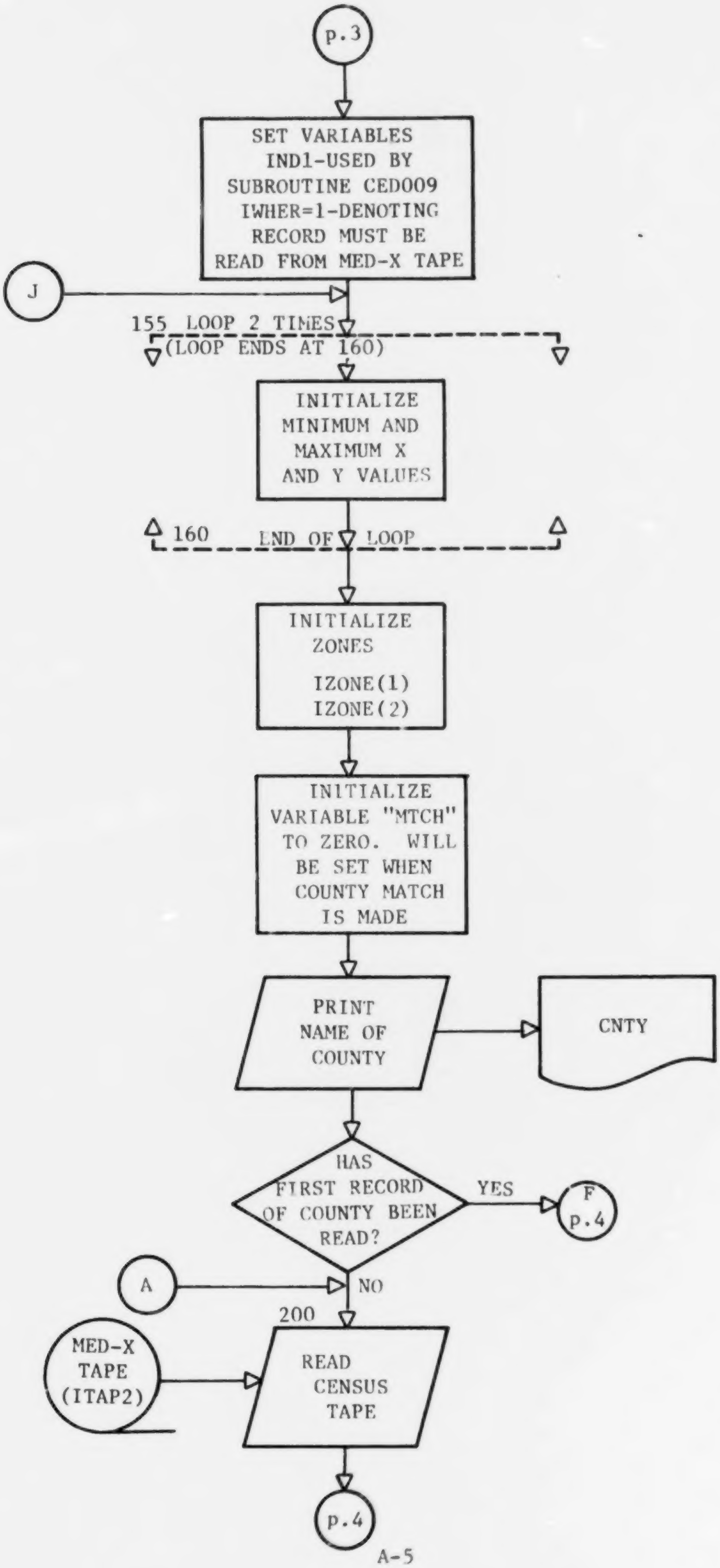
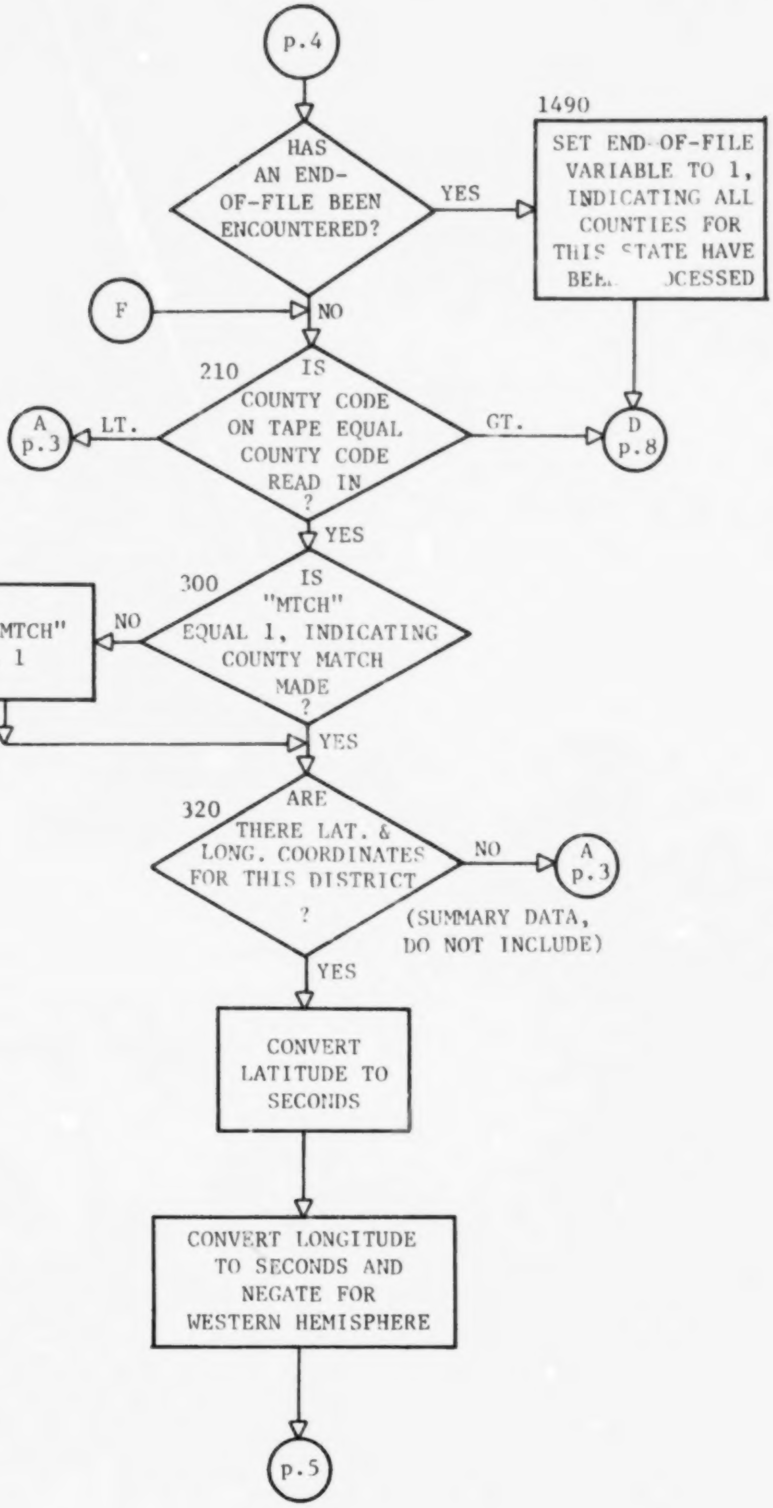
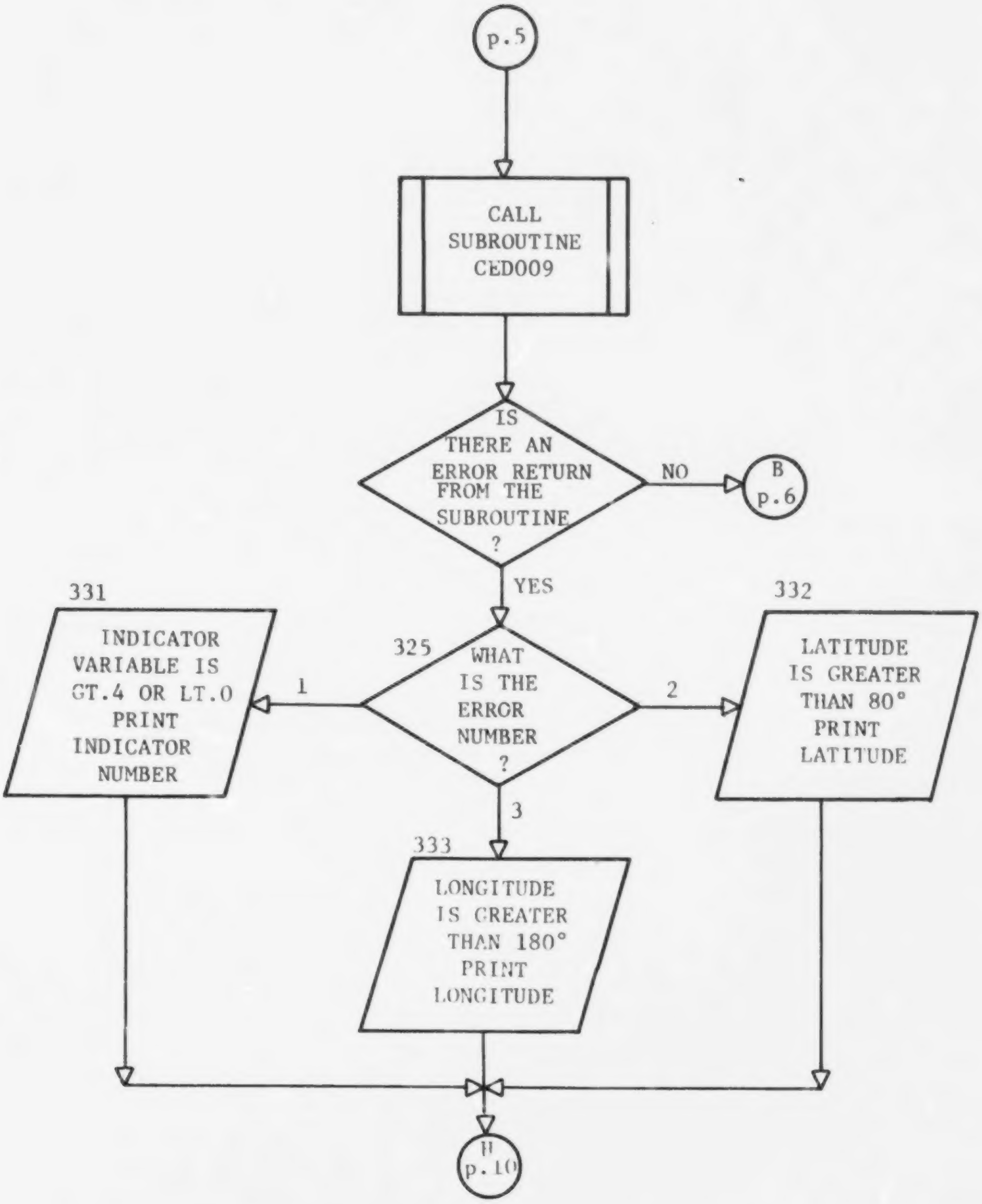
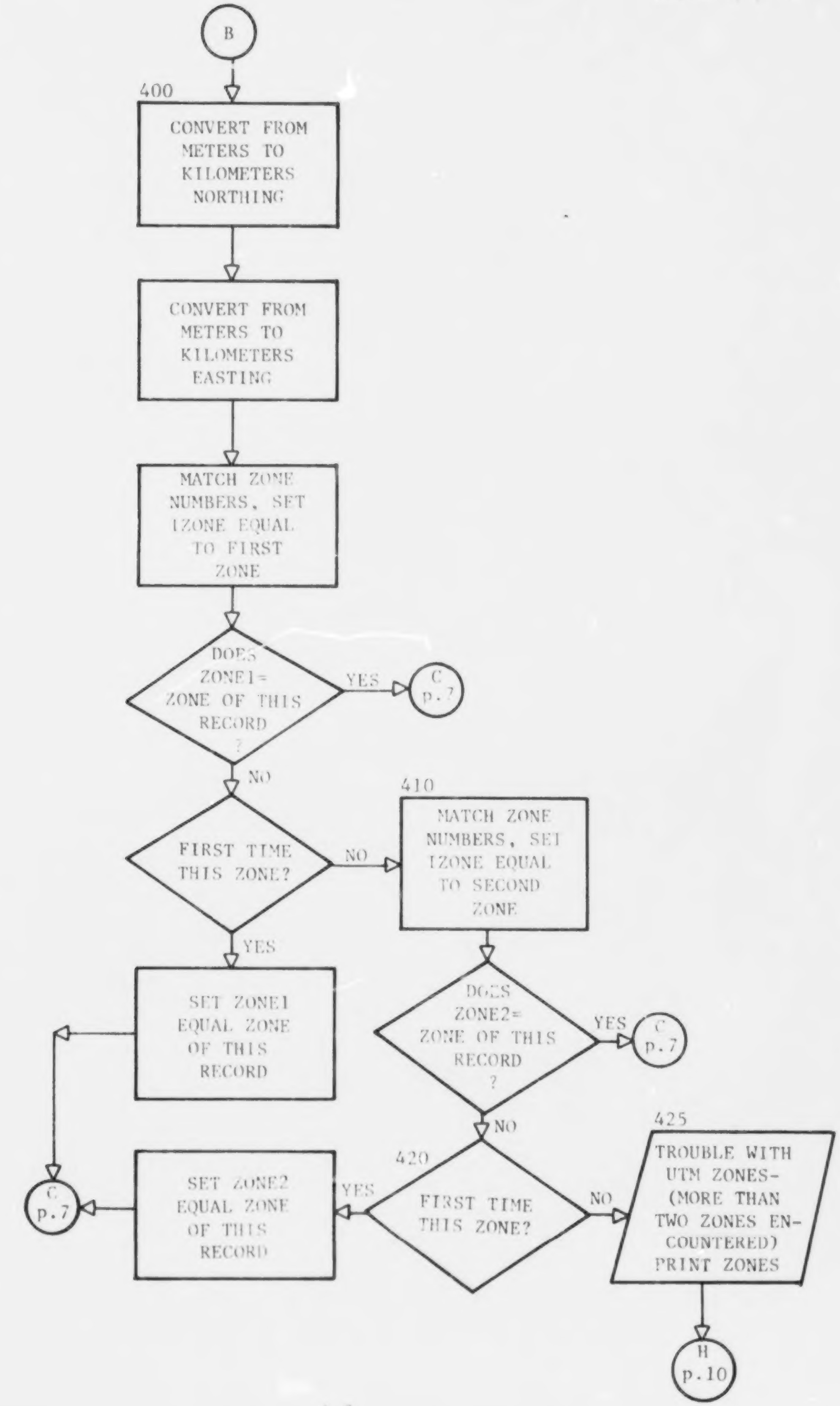
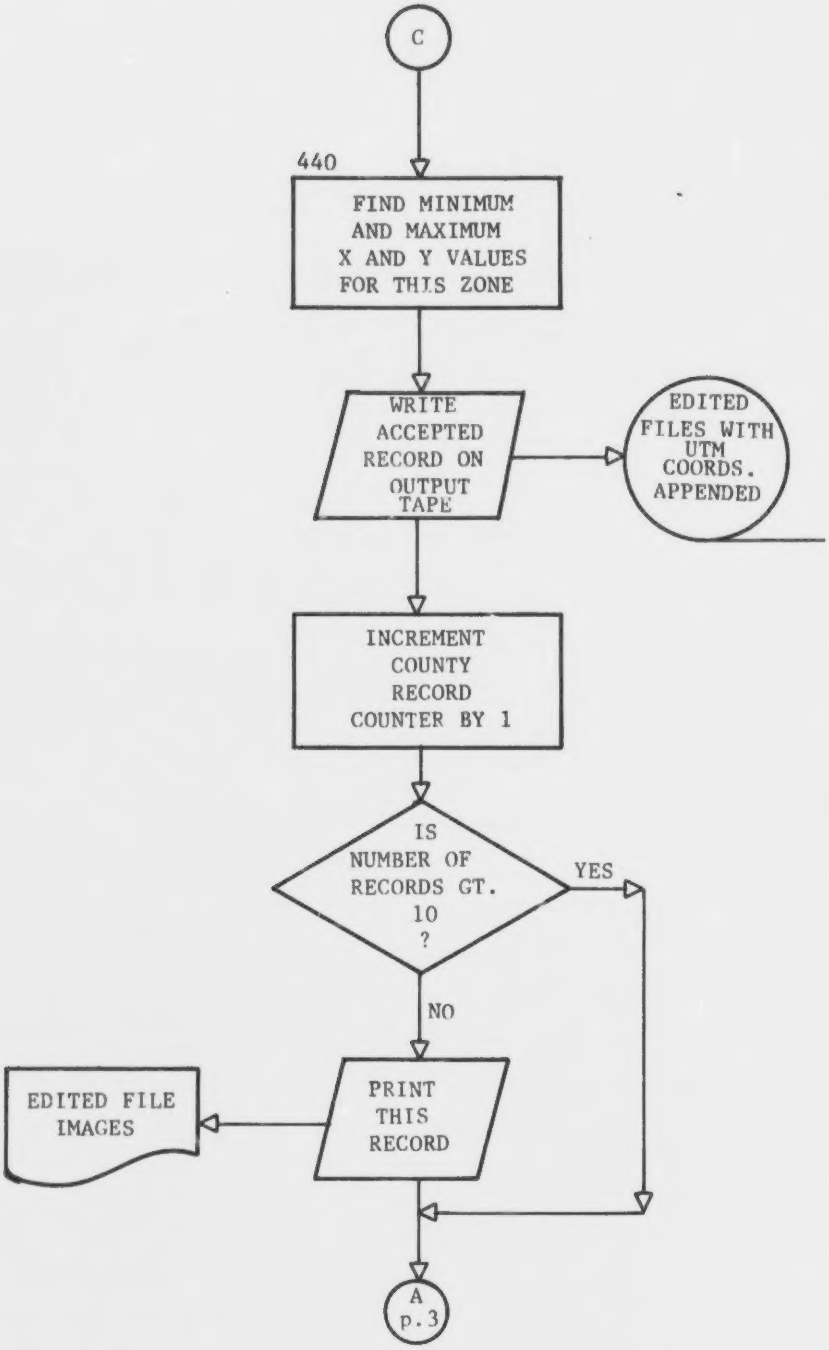

p.2
100
INITIALIZE END-OF-FILE VARIABLE (IEND=0)
NCNTY,STATE
READ NO. OF COUNTIES IN STATE AND STATE NAME
ICNTY(N),CNTY(M,N)
READ FEDERAL COUNTY CODE AND COUNTY NAME OF EACH COUNTY IN THE STATE
PRINT STATE NAME AND NUMBER OF COUNTIES FOR THIS STATE
STATE, NCNTY
LOOP ON NUMBER OF COUNTIES IN STATE
(LOOP ENDS AT 150)
INITIALIZE RECORD COUNTER TO ZERO FOR EACH COUNTY (IREC=0)
150
END OF LOOP
p.3

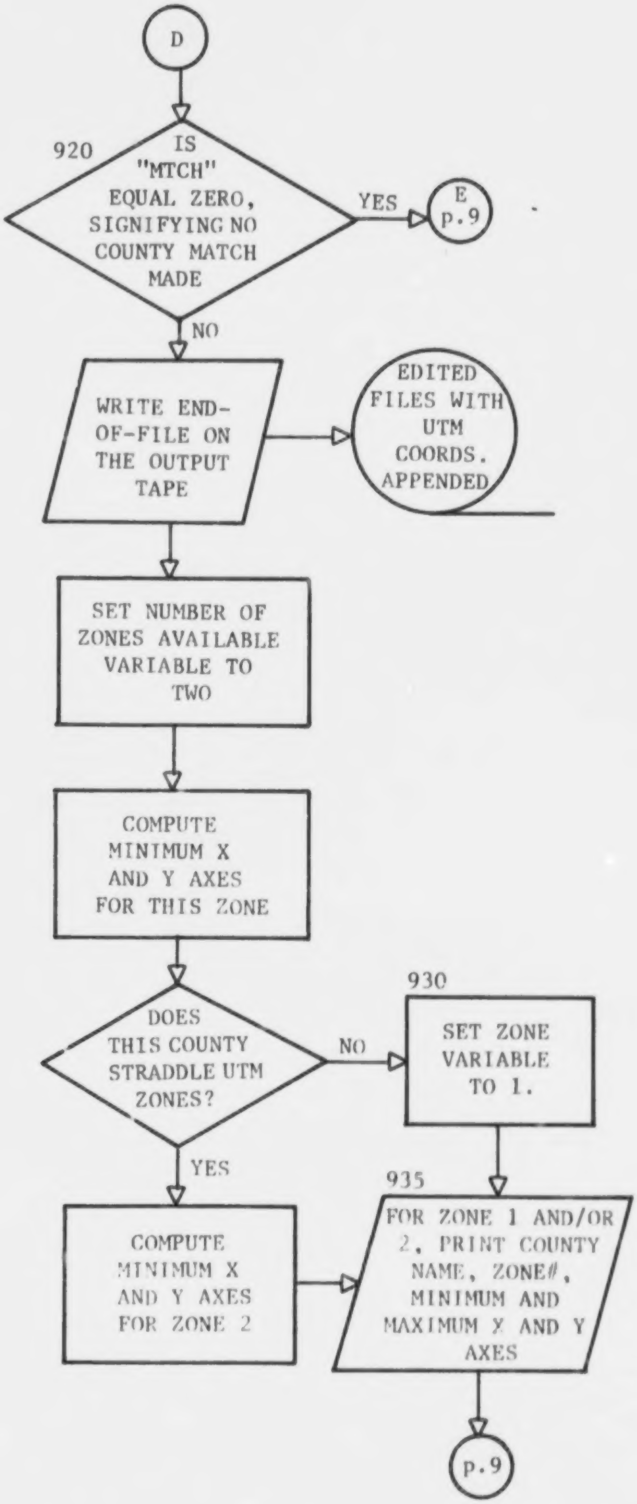

p.3
SET VARIABLES IND1-USED BY SUBROUTINE CED009 IWHER=1-DENOTING RECORD MUST BE READ FROM MED-X TAPE
J
155 LOOP 2 TIMES (LOOP ENDS AT 160)
INITIALIZE MINIMUM AND MAXIMUM X AND Y VALUES
160 END OF LOOP
INITIALIZE ZONES IZONE(1) IZONE(2)
INITIALIZE VARIABLE "MTCH" TO ZERO. WILL BE SET WHEN COUNTY MATCH IS MADE
PRINT NAME OF COUNTY
CNTY
HAS FIRST RECORD OF COUNTY BEEN READ?
YES
F p.4
A
NO
200
MED-X TAPE (ITAP2)
READ CENSUS TAPE
p.4

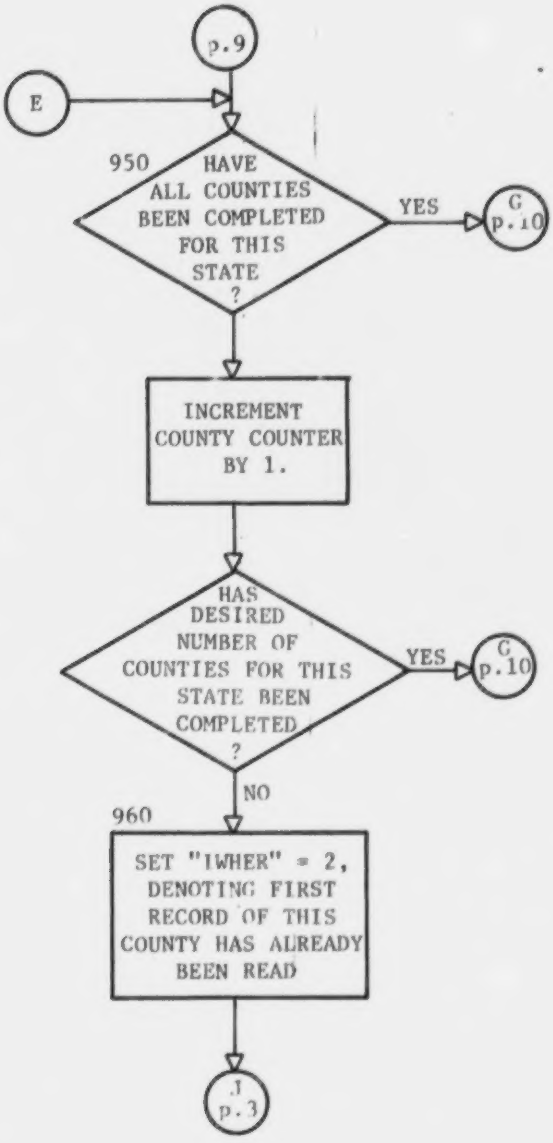

p.4
HAS AN END-OF-FILE BEEN ENCOUNTERED?
YES
1490
SET END-OF-FILE VARIABLE TO 1, INDICATING ALL COUNTIES FOR THIS STATE HAVE BEEN PROCESSED
F
NO
210
IS COUNTY CODE ON TAPE EQUAL COUNTY CODE READ IN ?
LT.
A p.3
GT.
D p.8
YES
300
IS "MTCH" EQUAL 1, INDICATING COUNTY MATCH MADE ?
NO
SET "MTCH" EQUAL 1
YES
320
ARE THERE LAT. & LONG. COORDINATES FOR THIS DISTRICT ?
NO
A p.3
(SUMMARY DATA, DO NOT INCLUDE)
YES
CONVERT LATITUDE TO SECONDS
CONVERT LONGITUDE TO SECONDS AND NEGATE FOR WESTERN HEMISPHERE
p.5

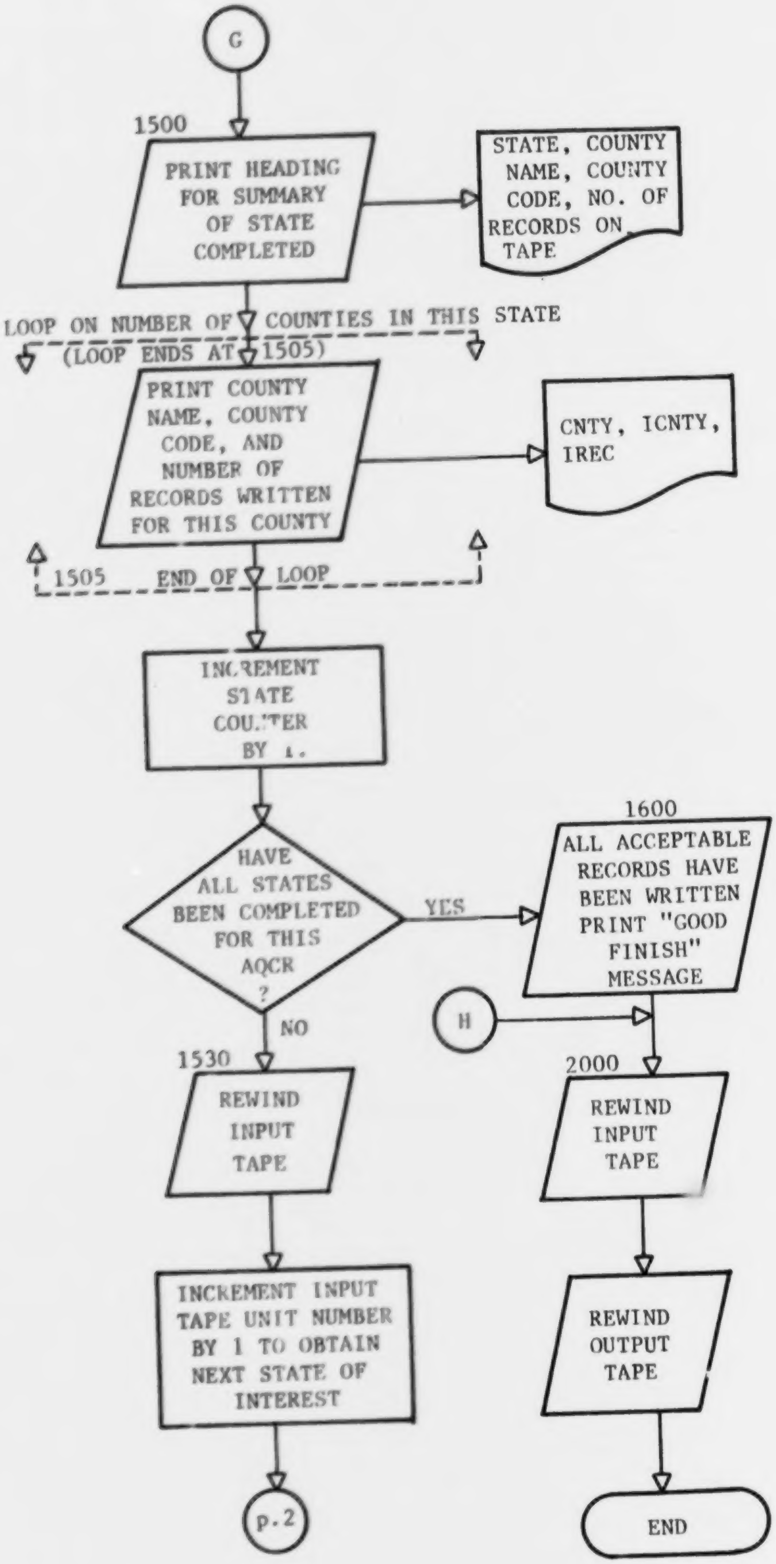

p.5
CALL SUBROUTINE CED009
IS THERE AN ERROR RETURN FROM THE SUBROUTINE ?
NO
B p.6
YES
325
WHAT IS THE ERROR NUMBER ?
1
2
3
331
INDICATOR VARIABLE IS GT.4 OR LT.0 PRINT INDICATOR NUMBER
332
LATITUDE IS GREATER THAN 80° PRINT LATITUDE
333
LONGITUDE IS GREATER THAN 180° PRINT LONGITUDE
H p.10

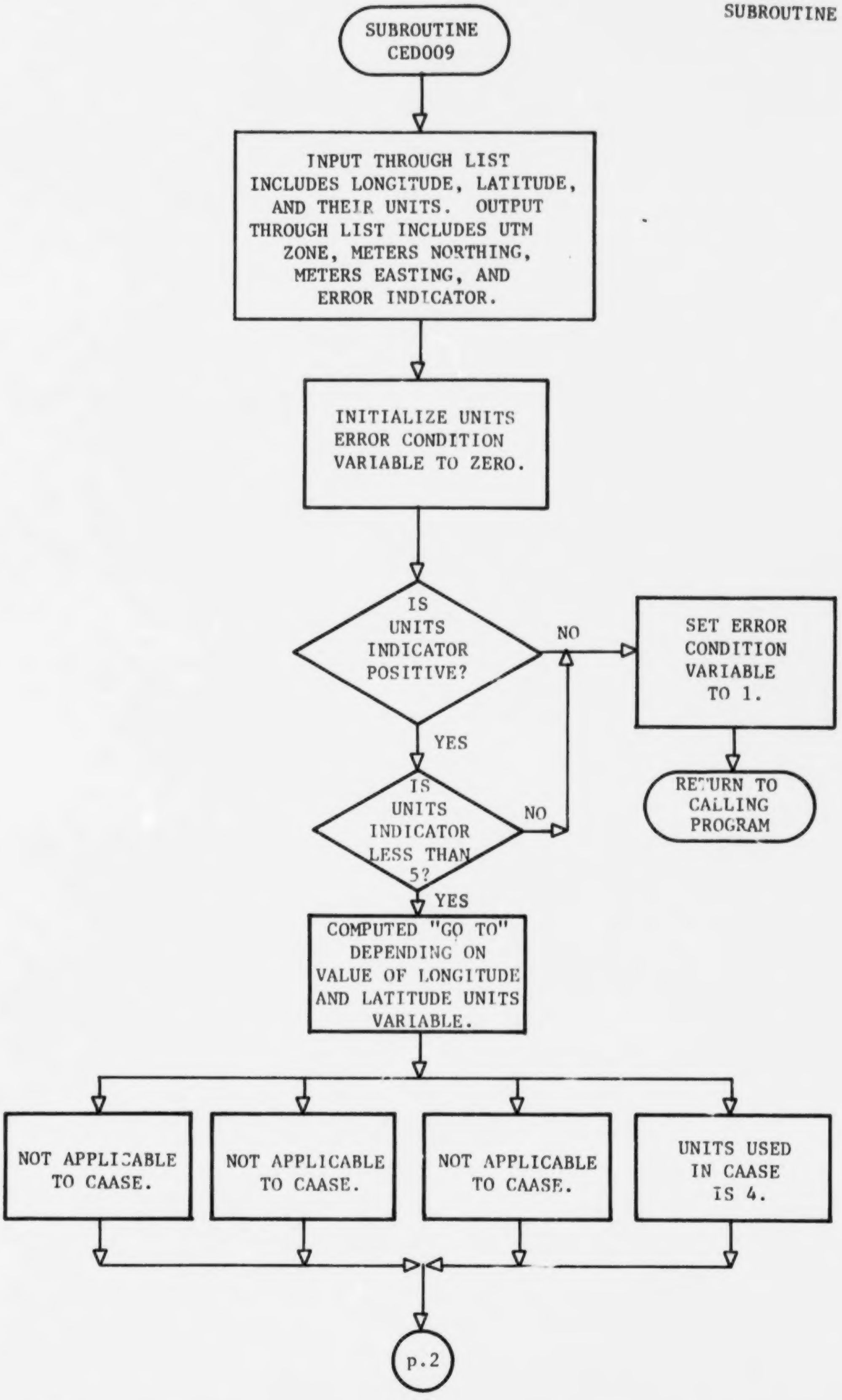

B
400
CONVERT FROM METERS TO KILOMETERS NORTHING
CONVERT FROM METERS TO KILOMETERS EASTING
MATCH ZONE NUMBERS, SET IZONE EQUAL TO FIRST ZONE
DOES ZONE1= ZONE OF THIS RECORD ?
YES
C p.7
NO
FIRST TIME THIS ZONE?
NO
410
MATCH ZONE NUMBERS, SET IZONE EQUAL TO SECOND ZONE
YES
SET ZONE1 EQUAL ZONE OF THIS RECORD
DOES ZONE2= ZONE OF THIS RECORD ?
YES
C p.7
NO
425
TROUBLE WITH UTM ZONES- (MORE THAN TWO ZONES ENCOUNTERED) PRINT ZONES
420
FIRST TIME THIS ZONE?
YES
NO
SET ZONE2 EQUAL ZONE OF THIS RECORD
C p.7
H p.10

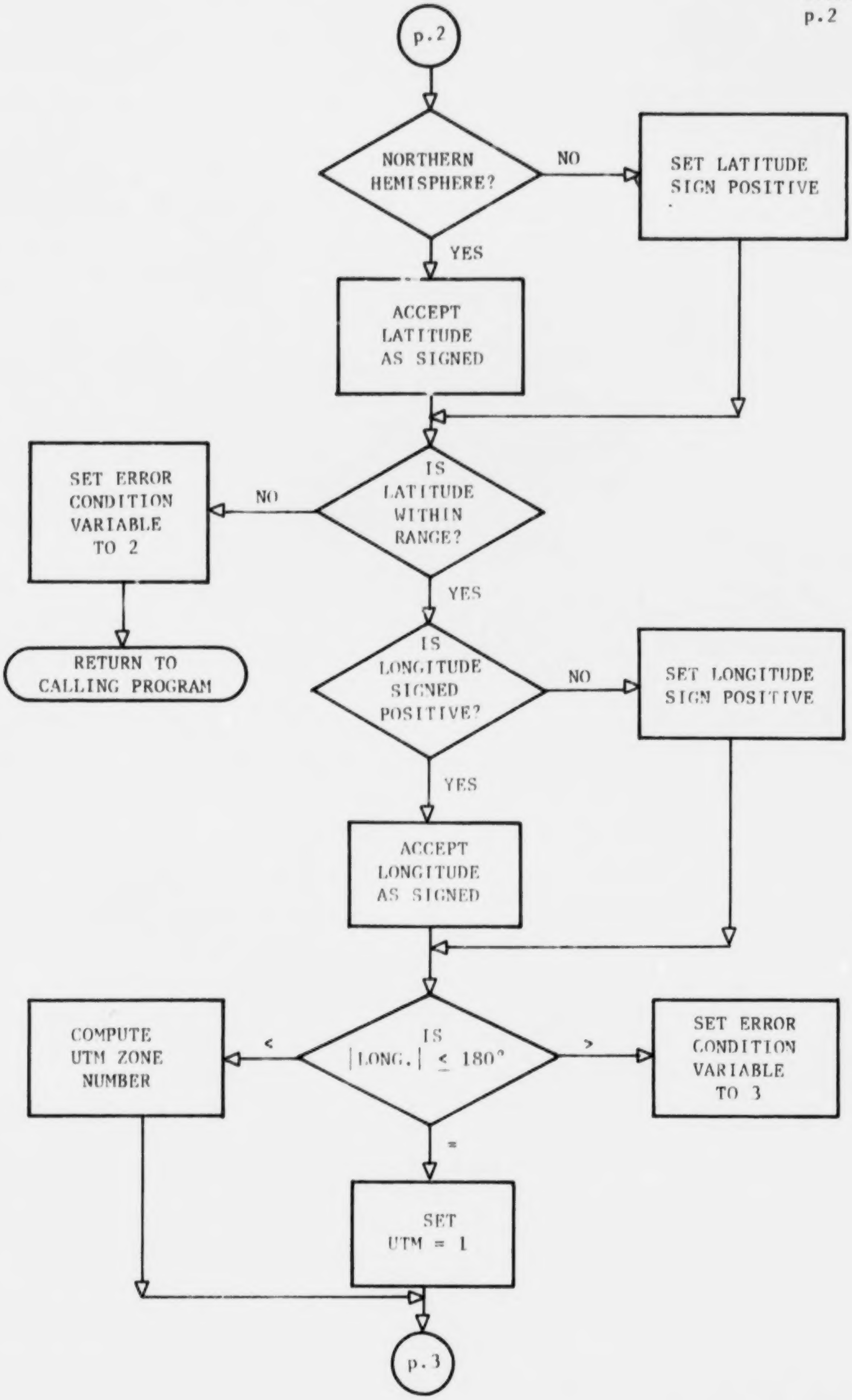

C
440
FIND MINIMUM AND MAXIMUM X AND Y VALUES FOR THIS ZONE
WRITE ACCEPTED RECORD ON OUTPUT TAPE
EDITED FILES WITH UTM COORDS. APPENDED
INCREMENT COUNTY RECORD COUNTER BY 1
IS NUMBER OF RECORDS GT. 10 ?
YES
NO
PRINT THIS RECORD
EDITED FILE IMAGES
A p.3

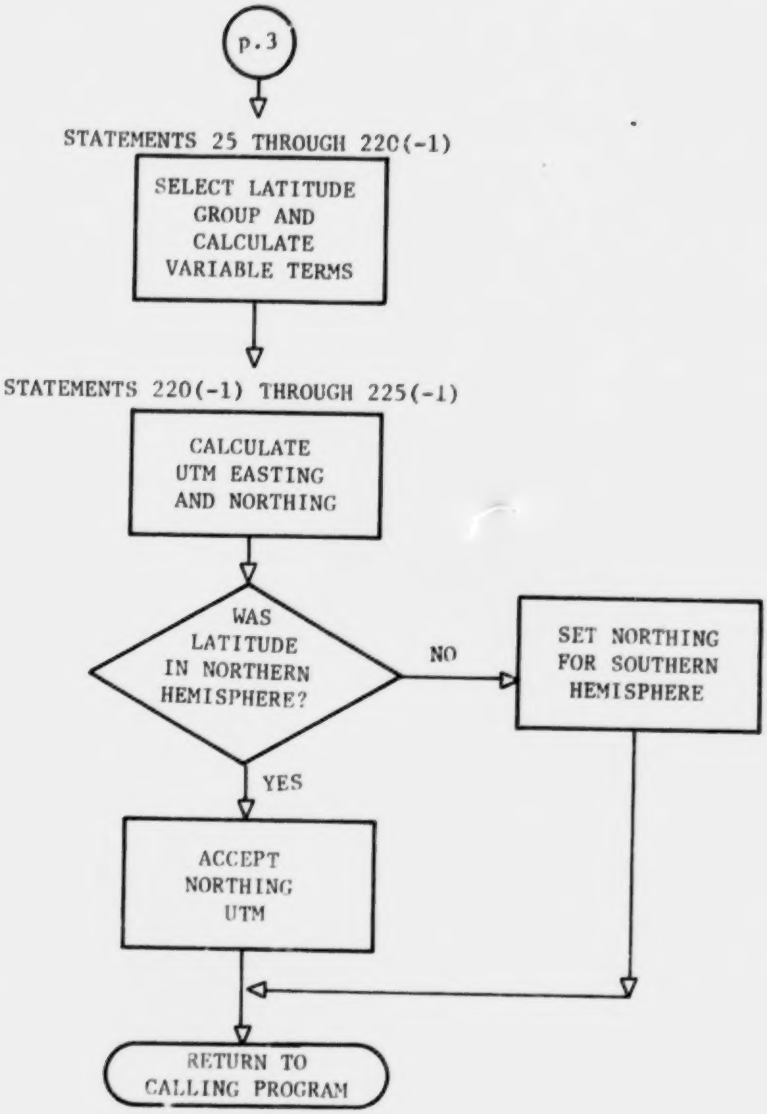

D
920
IS "MTCH" EQUAL ZERO, SIGNIFYING NO COUNTY MATCH MADE
YES
E p.9
NO
WRITE END-OF-FILE ON THE OUTPUT TAPE
EDITED FILES WITH UTM COORDS. APPENDED
SET NUMBER OF ZONES AVAILABLE VARIABLE TO TWO
COMPUTE MINIMUM X AND Y AXES FOR THIS ZONE
DOES THIS COUNTY STRADDLE UTM ZONES?
NO
930
SET ZONE VARIABLE TO 1.
YES
935
COMPUTE MINIMUM X AND Y AXES FOR ZONE 2
FOR ZONE 1 AND/OR 2, PRINT COUNTY NAME, ZONE#, MINIMUM AND MAXIMUM X AND Y AXES
p.9


p.9
E
950
HAVE ALL COUNTIES BEEN COMPLETED FOR THIS STATE ?
YES
G p.10
INCREMENT COUNTY COUNTER BY 1.
HAS DESIRED NUMBER OF COUNTIES FOR THIS STATE BEEN COMPLETED ?
YES
G p.10
NO
960
SET "IWHER" = 2, DENOTING FIRST RECORD OF THIS COUNTY HAS ALREADY BEEN READ
J p.3


G
1500
PRINT HEADING FOR SUMMARY OF STATE COMPLETED
STATE, COUNTY NAME, COUNTY CODE, NO. OF RECORDS ON TAPE
LOOP ON NUMBER OF COUNTIES IN THIS STATE
(LOOP ENDS AT 1505)
PRINT COUNTY NAME, COUNTY CODE, AND NUMBER OF RECORDS WRITTEN FOR THIS COUNTY
CNTY, ICNTY, IREC
1505 END OF LOOP
INCREMENT STATE COUNTER BY 1.
HAVE ALL STATES BEEN COMPLETED FOR THIS AQCR ?
YES
1600
ALL ACCEPTABLE RECORDS HAVE BEEN WRITTEN PRINT "GOOD FINISH" MESSAGE
NO
1530
REWIND INPUT TAPE
H
2000
REWIND INPUT TAPE
INCREMENT INPUT TAPE UNIT NUMBER BY 1 TO OBTAIN NEXT STATE OF INTEREST
REWIND OUTPUT TAPE
p.2
END


SUBROUTINE CED009
INPUT THROUGH LIST INCLUDES LONGITUDE, LATITUDE, AND THEIR UNITS. OUTPUT THROUGH LIST INCLUDES UTM ZONE, METERS NORTHING, METERS EASTING, AND ERROR INDICATOR.
INITIALIZE UNITS ERROR CONDITION VARIABLE TO ZERO.
IS UNITS INDICATOR POSITIVE?
NO
SET ERROR CONDITION VARIABLE TO 1.
RETURN TO CALLING PROGRAM
YES
IS UNITS INDICATOR LESS THAN 5?
NO
YES
COMPUTED "GO TO" DEPENDING ON VALUE OF LONGITUDE AND LATITUDE UNITS VARIABLE.
NOT APPLICABLE TO CAASE.
NOT APPLICABLE TO CAASE.
NOT APPLICABLE TO CAASE.
UNITS USED IN CAASE IS 4.
p.2


p.2
NORTHERN HEMISPHERE?
NO
SET LATITUDE SIGN POSITIVE
YES
ACCEPT LATITUDE AS SIGNED
IS LATITUDE WITHIN RANGE?
NO
SET ERROR CONDITION VARIABLE TO 2
RETURN TO CALLING PROGRAM
YES
IS LONGITUDE SIGNED POSITIVE?
NO
SET LONGITUDE SIGN POSITIVE
YES
ACCEPT LONGITUDE AS SIGNED
IS |LONG.| ≤ 180°
<
COMPUTE UTM ZONE NUMBER
>
SET ERROR CONDITION VARIABLE TO 3
=
SET UTM = 1
p.3


p.3
STATEMENTS 25 THROUGH 220(-1)
SELECT LATITUDE GROUP AND CALCULATE VARIABLE TERMS
STATEMENTS 220(-1) THROUGH 225(-1)
CALCULATE UTM EASTING AND NORTHING
WAS LATITUDE IN NORTHERN HEMISPHERE?
NO
SET NORTHING FOR SOUTHERN HEMISPHERE
YES
ACCEPT NORTHING UTM
RETURN TO CALLING PROGRAM

APPENDIX B

LOGICAL FLOW CHARTS — CAASE2 (and Subroutines)

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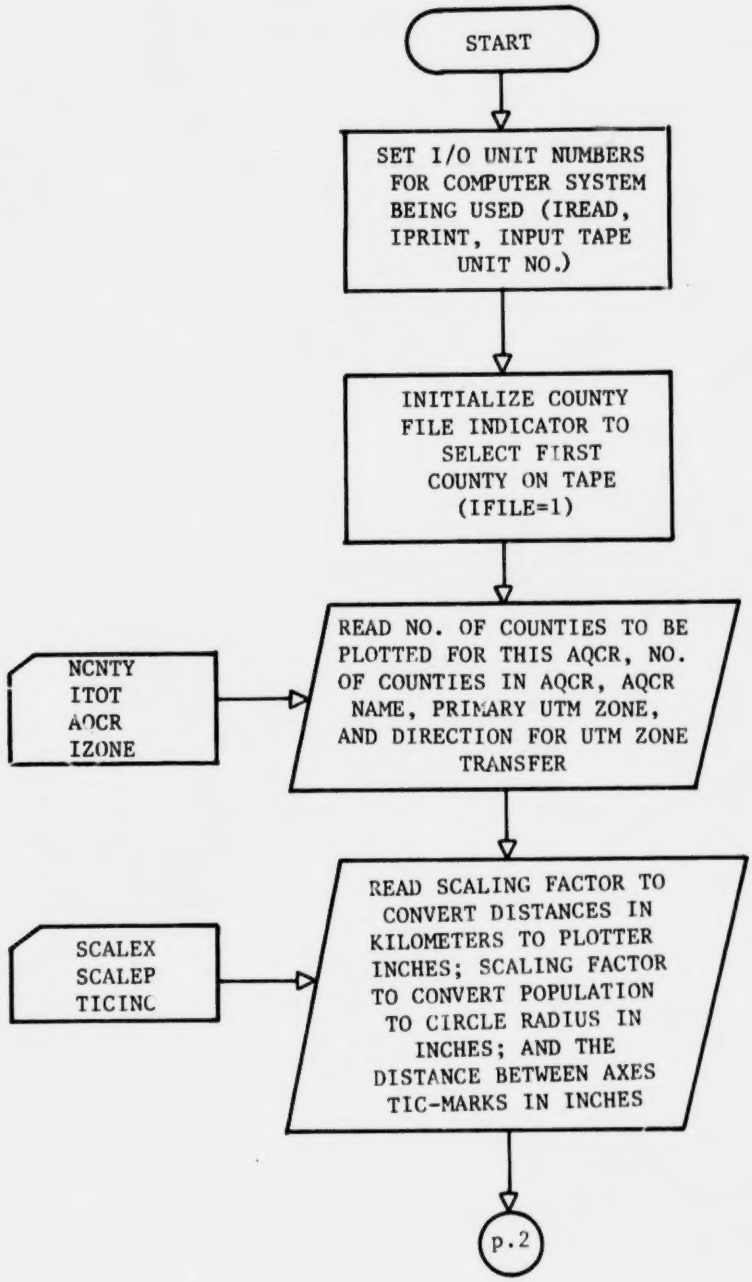
START
SET I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED (IREAD, IPRINT, INPUT TAPE UNIT NO.)
INITIALIZE COUNTY FILE INDICATOR TO SELECT FIRST COUNTY ON TAPE (IFILE=1)
NCNTY
ITOT
AQCR
IZONE
READ NO. OF COUNTIES TO BE PLOTTED FOR THIS AQCR, NO. OF COUNTIES IN AQCR, AQCR NAME, PRIMARY UTM ZONE, AND DIRECTION FOR UTM ZONE TRANSFER
SCALEX
SCALEP
TICINC
READ SCALING FACTOR TO CONVERT DISTANCES IN KILOMETERS TO PLOTTER INCHES; SCALING FACTOR TO CONVERT POPULATION TO CIRCLE RADIUS IN INCHES; AND THE DISTANCE BETWEEN AXES TIC-MARKS IN INCHES
p.2

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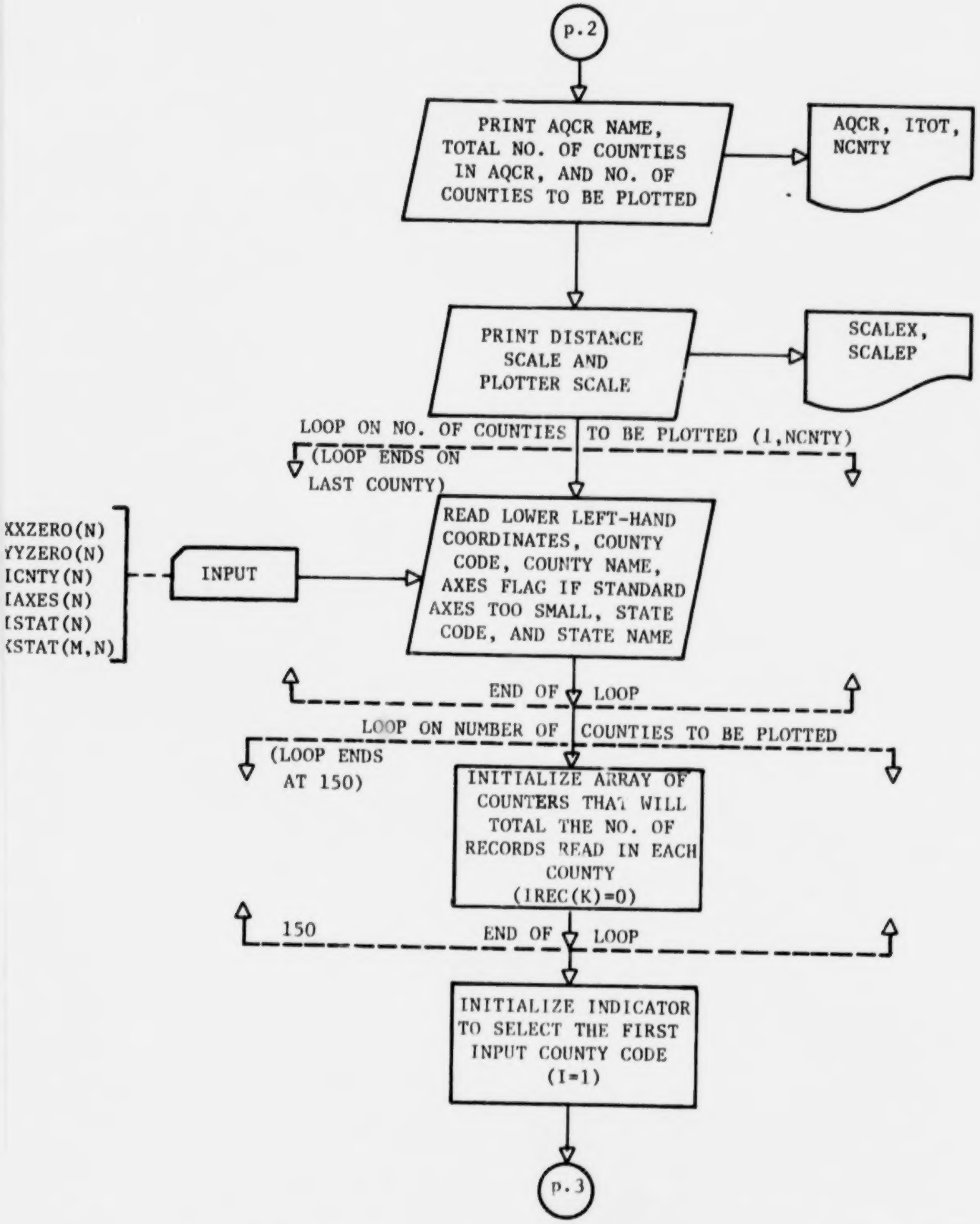
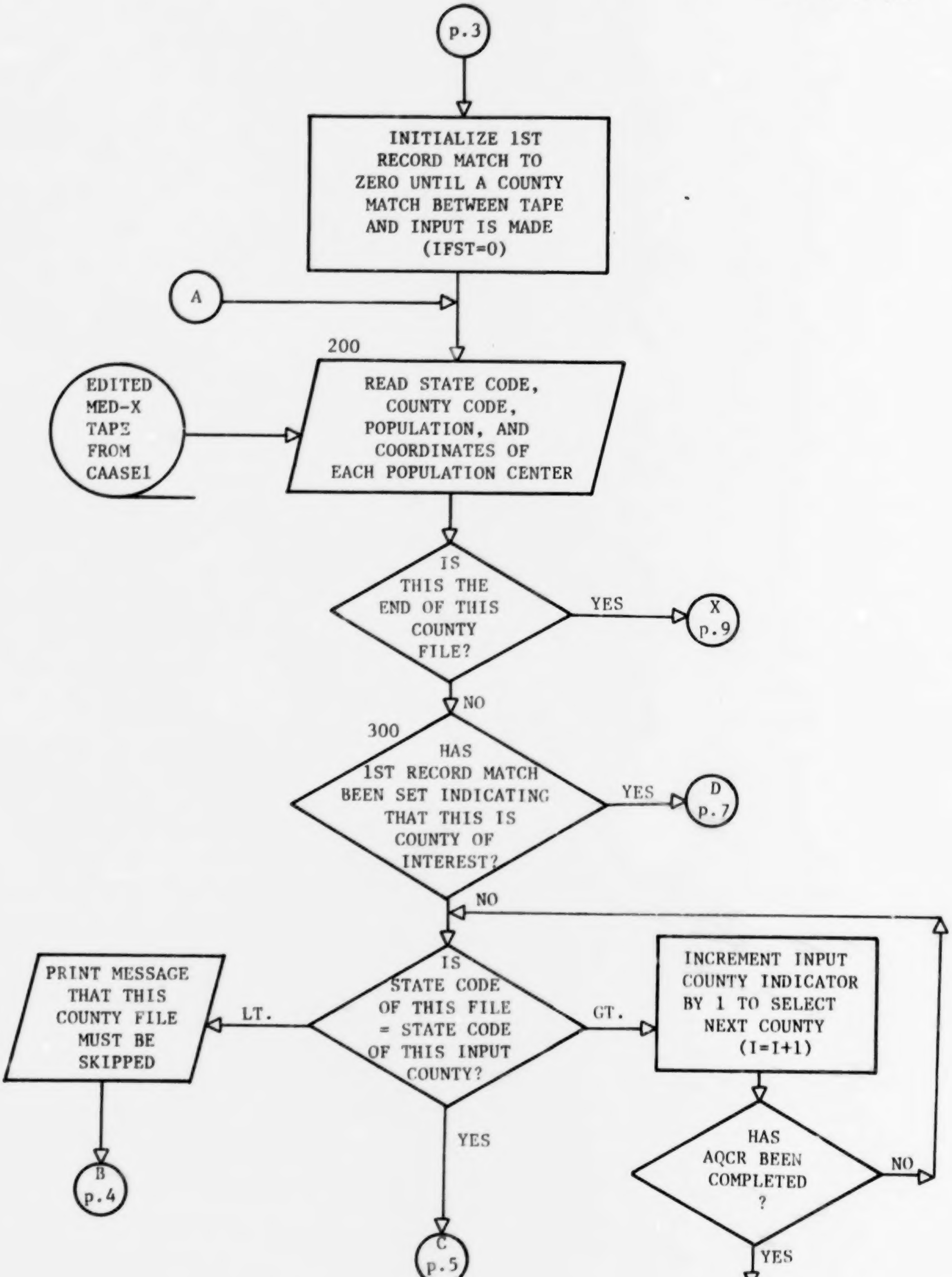
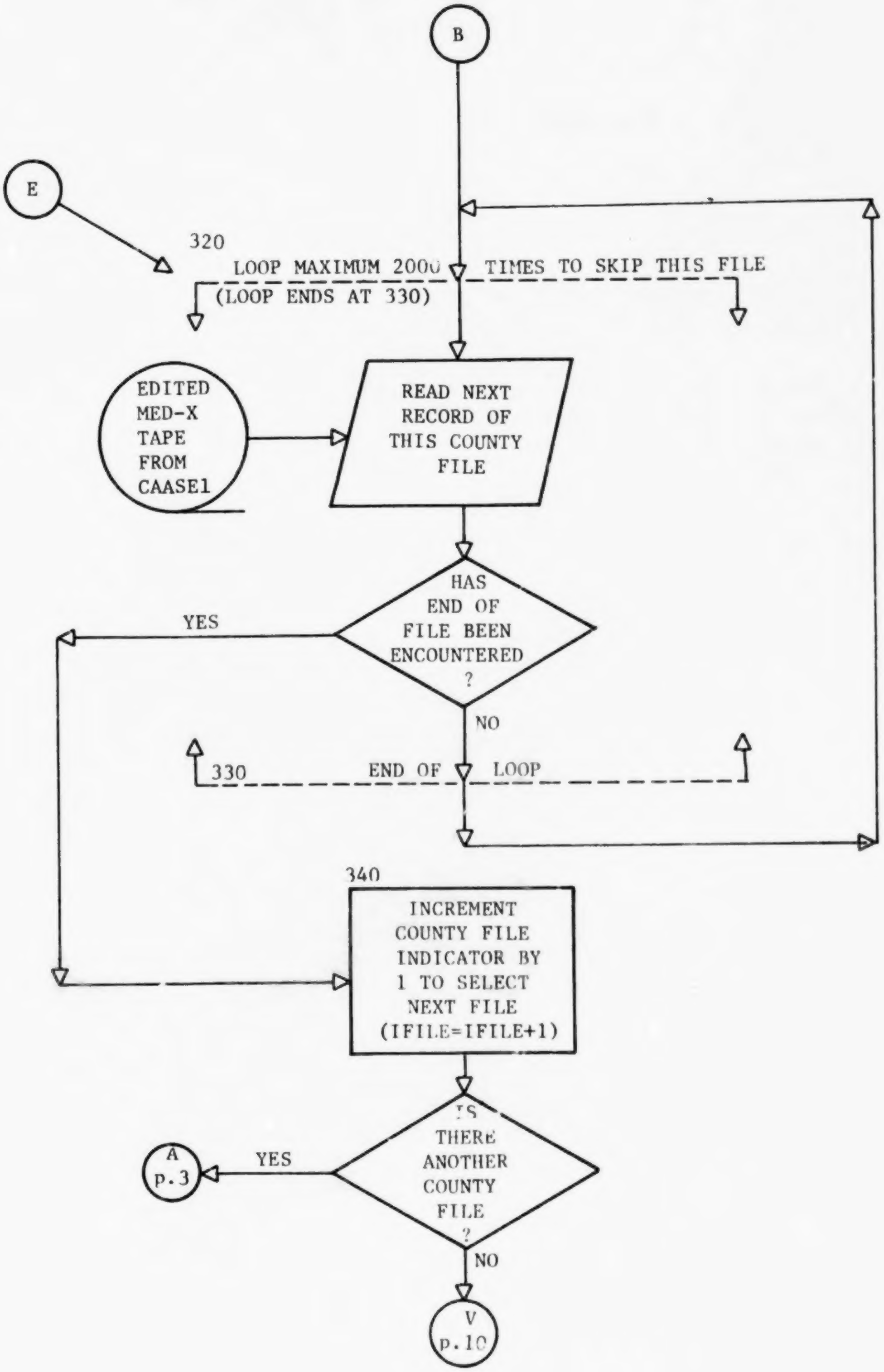
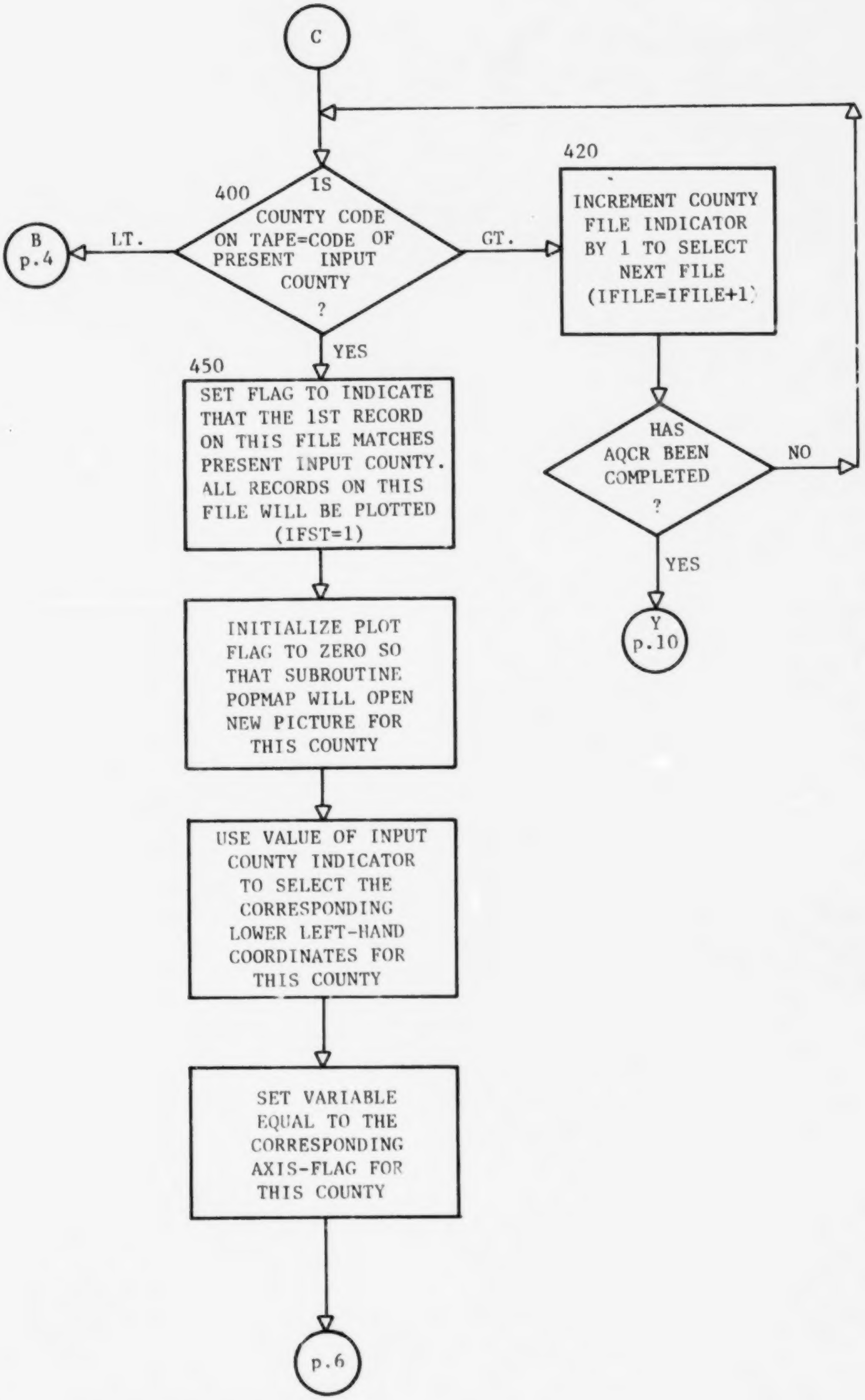
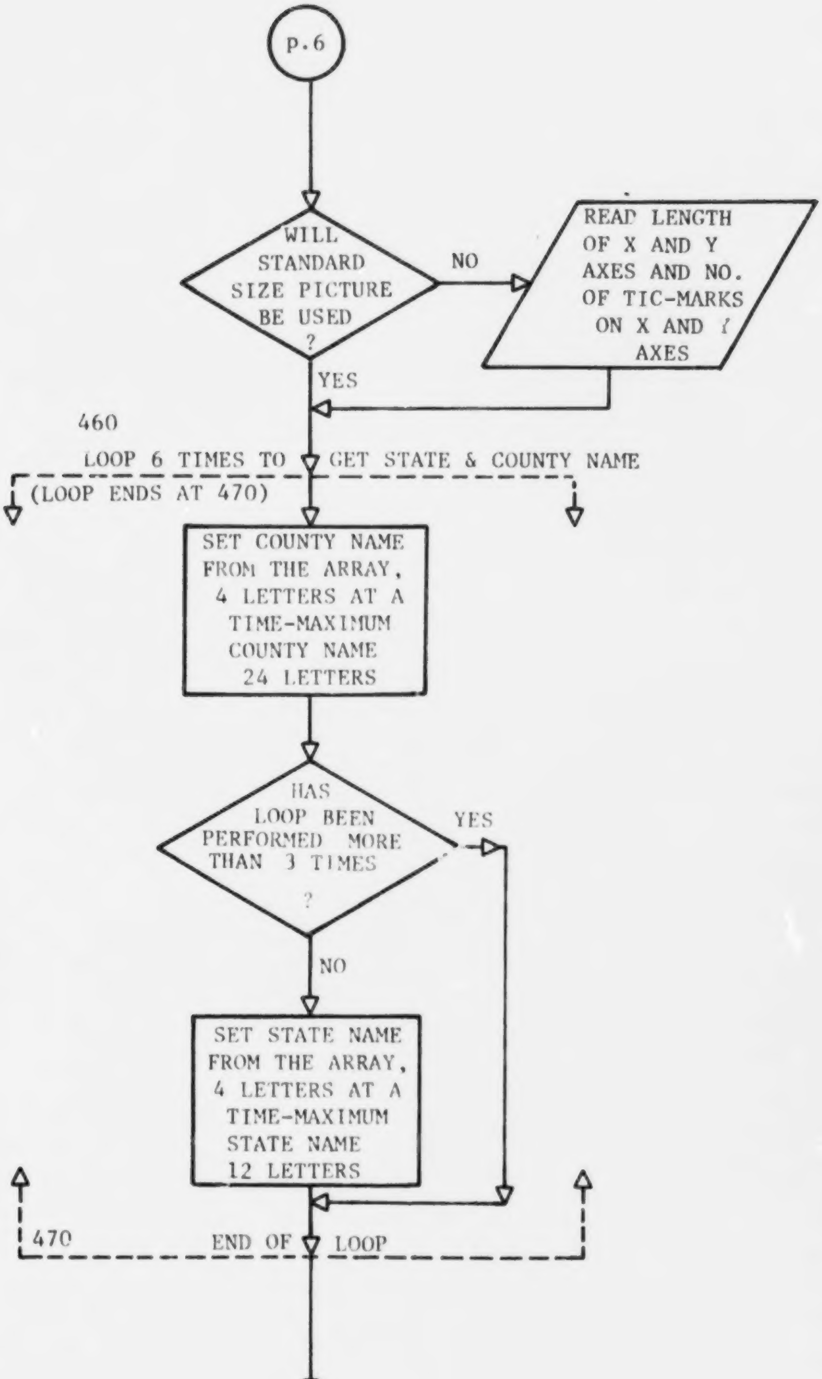

p.2
PRINT AQCR NAME, TOTAL NO. OF COUNTIES IN AQCR, AND NO. OF COUNTIES TO BE PLOTTED
AQCR, ITOT, NCNTY
PRINT DISTANCE SCALE AND PLOTTER SCALE
SCALEX, SCALEP
LOOP ON NO. OF COUNTIES TO BE PLOTTED (1,NCNTY)
(LOOP ENDS ON LAST COUNTY)
XXZERO(N)
YYZERO(N)
ICNTY(N)
IAXES(N)
ISTAT(N)
XSTAT(M,N)
INPUT
READ LOWER LEFT-HAND COORDINATES, COUNTY CODE, COUNTY NAME, AXES FLAG IF STANDARD AXES TOO SMALL, STATE CODE, AND STATE NAME
END OF LOOP
LOOP ON NUMBER OF COUNTIES TO BE PLOTTED
(LOOP ENDS AT 150)
INITIALIZE ARRAY OF COUNTERS THAT WILL TOTAL THE NO. OF RECORDS READ IN EACH COUNTY (IREC(K)=0)
150
END OF LOOP
INITIALIZE INDICATOR TO SELECT THE FIRST INPUT COUNTY CODE (I=1)
p.3

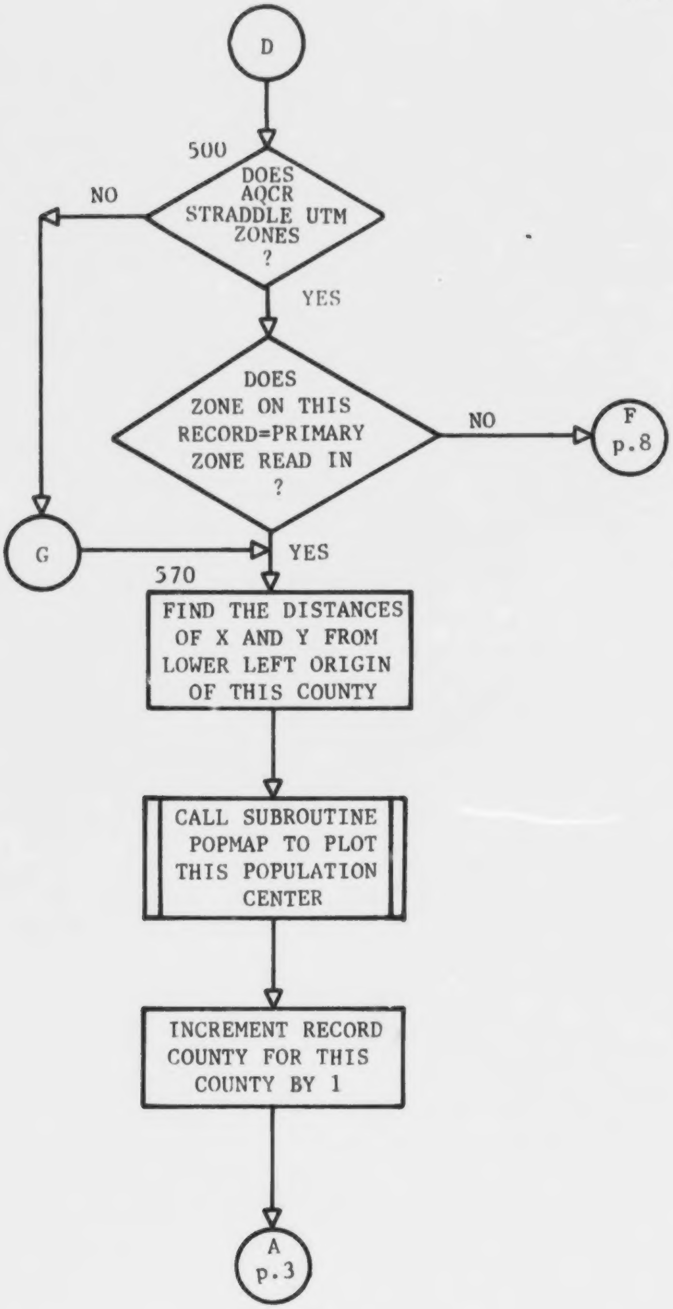
Reproduced from best available copy.

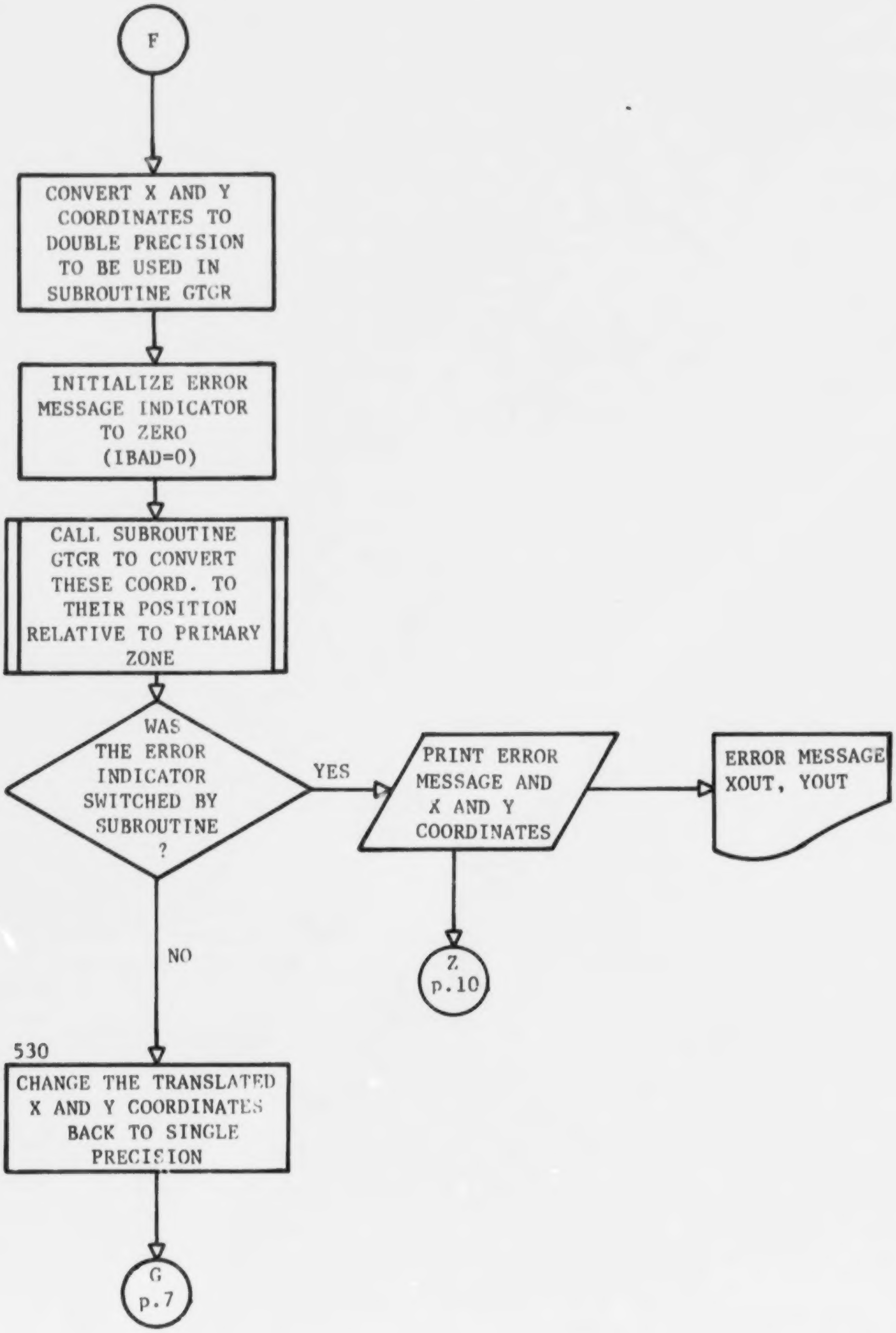

p.3
INITIALIZE 1ST RECORD MATCH TO ZERO UNTIL A COUNTY MATCH BETWEEN TAPE AND INPUT IS MADE (IFST=0)
A
200
EDITED MED-X TAPE FROM CAASE1
READ STATE CODE, COUNTY CODE, POPULATION, AND COORDINATES OF EACH POPULATION CENTER
IS THIS THE END OF THIS COUNTY FILE?
YES
X p.9
NO
300
HAS 1ST RECORD MATCH BEEN SET INDICATING THAT THIS IS COUNTY OF INTEREST?
YES
D p.7
NO
IS STATE CODE OF THIS FILE = STATE CODE OF THIS INPUT COUNTY?
LT.
PRINT MESSAGE THAT THIS COUNTY FILE MUST BE SKIPPED
B p.4
GT.
INCREMENT INPUT COUNTY INDICATOR BY 1 TO SELECT NEXT COUNTY (I=I+1)
HAS AQCR BEEN COMPLETED ?
NO
YES
Y p.10
YES
C p.5

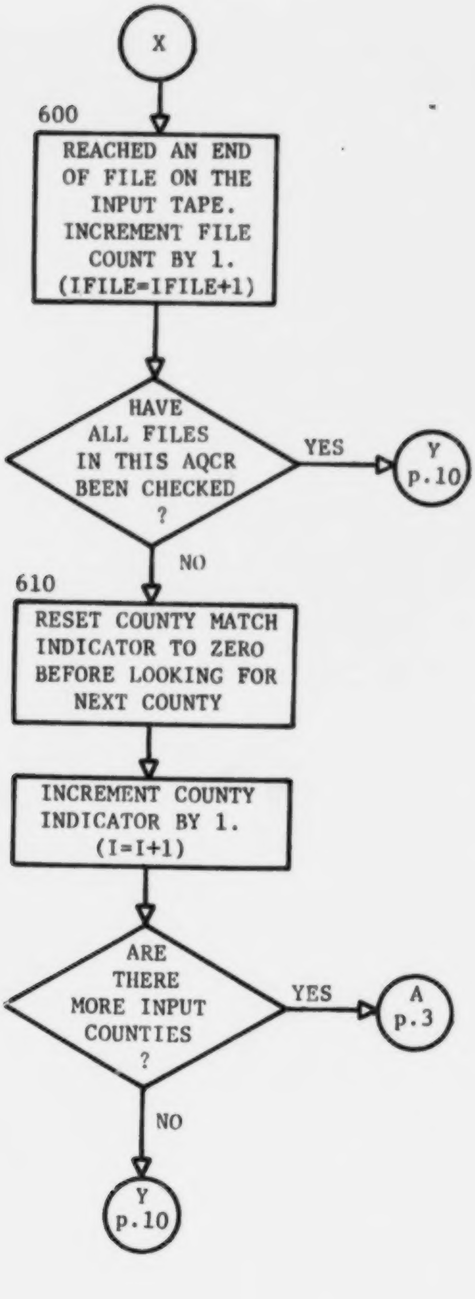

B
E
320
LOOP MAXIMUM 2000 TIMES TO SKIP THIS FILE
(LOOP ENDS AT 330)
EDITED MED-X TAPE FROM CAASE1
READ NEXT RECORD OF THIS COUNTY FILE
HAS END OF FILE BEEN ENCOUNTERED ?
YES
NO
330
END OF LOOP
340
INCREMENT COUNTY FILE INDICATOR BY 1 TO SELECT NEXT FILE (IFILE=IFILE+1)
IS THERE ANOTHER COUNTY FILE ?
YES
A p.3
NO
V p.10

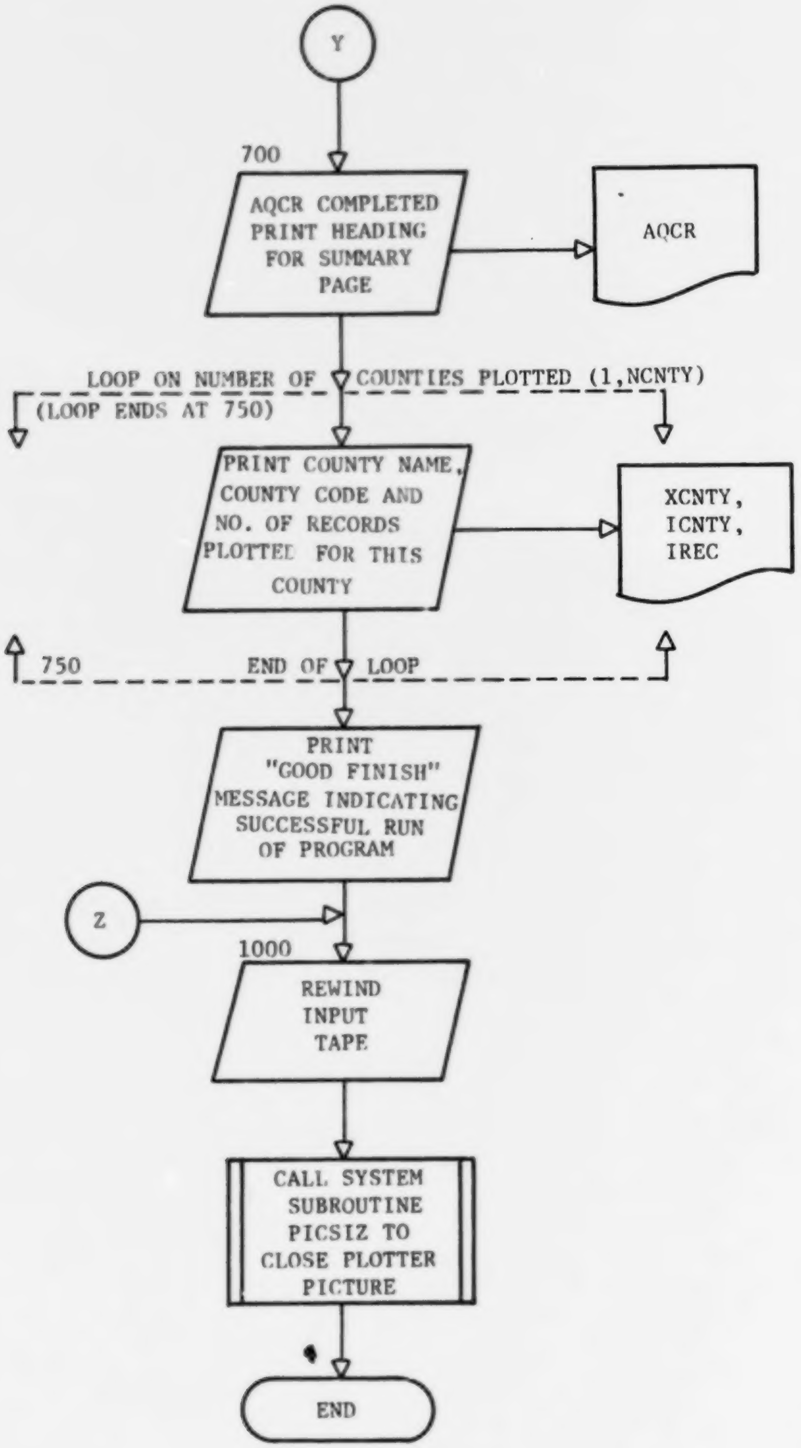

C
400
IS COUNTY CODE ON TAPE=CODE OF PRESENT INPUT COUNTY ?
LT.
B p.4
GT.
420
INCREMENT COUNTY FILE INDICATOR BY 1 TO SELECT NEXT FILE (IFILE=IFILE+1)
HAS AQCR BEEN COMPLETED ?
NO
YES
Y p.10
YES
450
SET FLAG TO INDICATE THAT THE 1ST RECORD ON THIS FILE MATCHES PRESENT INPUT COUNTY. ALL RECORDS ON THIS FILE WILL BE PLOTTED (IFST=1)
INITIALIZE PLOT FLAG TO ZERO SO THAT SUBROUTINE POPMAP WILL OPEN NEW PICTURE FOR THIS COUNTY
USE VALUE OF INPUT COUNTY INDICATOR TO SELECT THE CORRESPONDING LOWER LEFT-HAND COORDINATES FOR THIS COUNTY
SET VARIABLE EQUAL TO THE CORRESPONDING AXIS-FLAG FOR THIS COUNTY
p.6

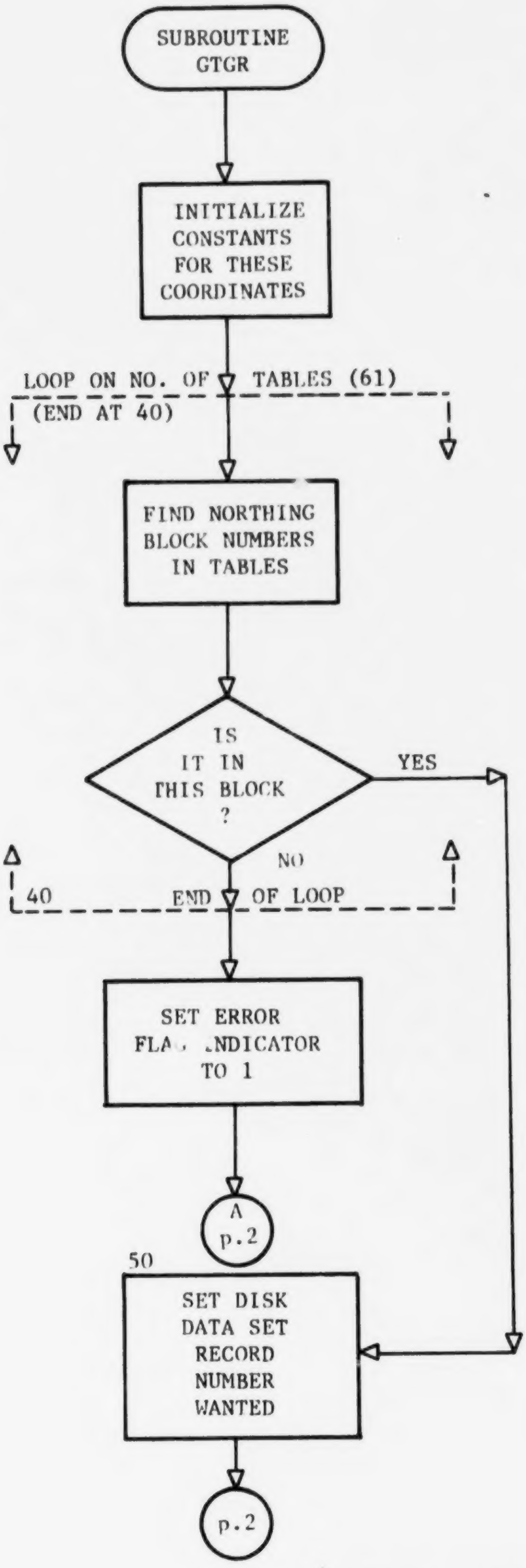

p.6
WILL STANDARD SIZE PICTURE BE USED ?
NO
READ LENGTH OF X AND Y AXES AND NO. OF TIC-MARKS ON X AND Y AXES
YES
460
LOOP 6 TIMES TO GET STATE & COUNTY NAME
(LOOP ENDS AT 470)
SET COUNTY NAME FROM THE ARRAY, 4 LETTERS AT A TIME-MAXIMUM COUNTY NAME 24 LETTERS
HAS LOOP BEEN PERFORMED MORE THAN 3 TIMES ?
YES
NO
SET STATE NAME FROM THE ARRAY, 4 LETTERS AT A TIME-MAXIMUM STATE NAME 12 LETTERS
470
END OF LOOP
D
p.7


D
500
DOES AQCR STRADDLE UTM ZONES ?
NO
YES
DOES ZONE ON THIS RECORD=PRIMARY ZONE READ IN ?
NO
F p.8
G
YES
570
FIND THE DISTANCES OF X AND Y FROM LOWER LEFT ORIGIN OF THIS COUNTY
CALL SUBROUTINE POPMAP TO PLOT THIS POPULATION CENTER
INCREMENT RECORD COUNTY FOR THIS COUNTY BY 1
A p.3


F
CONVERT X AND Y COORDINATES TO DOUBLE PRECISION TO BE USED IN SUBROUTINE GTGR
INITIALIZE ERROR MESSAGE INDICATOR TO ZERO (IBAD=0)
CALL SUBROUTINE GTGR TO CONVERT THESE COORD. TO THEIR POSITION RELATIVE TO PRIMARY ZONE
WAS THE ERROR INDICATOR SWITCHED BY SUBROUTINE ?
YES
PRINT ERROR MESSAGE AND X AND Y COORDINATES
ERROR MESSAGE XOUT, YOUT
Z p.10
NO
530
CHANGE THE TRANSLATED X AND Y COORDINATES BACK TO SINGLE PRECISION
G p.7


X
600
REACHED AN END OF FILE ON THE INPUT TAPE. INCREMENT FILE COUNT BY 1. (IFILE=IFILE+1)
HAVE ALL FILES IN THIS AQCR BEEN CHECKED ?
YES
Y p.10
NO
610
RESET COUNTY MATCH INDICATOR TO ZERO BEFORE LOOKING FOR NEXT COUNTY
INCREMENT COUNTY INDICATOR BY 1. (I=I+1)
ARE THERE MORE INPUT COUNTIES ?
YES
A p.3
NO
Y p.10


Y
700
AQCR COMPLETED PRINT HEADING FOR SUMMARY PAGE
AQCR
LOOP ON NUMBER OF COUNTIES PLOTTED (1,NCNTY)
(LOOP ENDS AT 750)
PRINT COUNTY NAME, COUNTY CODE AND NO. OF RECORDS PLOTTED FOR THIS COUNTY
XCNTY, ICNTY, IREC
750
END OF LOOP
PRINT "GOOD FINISH" MESSAGE INDICATING SUCCESSFUL RUN OF PROGRAM
Z
1000
REWIND INPUT TAPE
CALL SYSTEM SUBROUTINE PICSIZ TO CLOSE PLOTTER PICTURE
END


SUBROUTINE GTGR
INITIALIZE CONSTANTS FOR THESE COORDINATES
LOOP ON NO. OF TABLES (61)
(END AT 40)
FIND NORTHING BLOCK NUMBERS IN TABLES
IS IT IN THIS BLOCK ?
YES
NO
40
END OF LOOP
SET ERROR FLAG INDICATOR TO 1
A p.2
50
SET DISK DATA SET RECORD NUMBER WANTED
p.2

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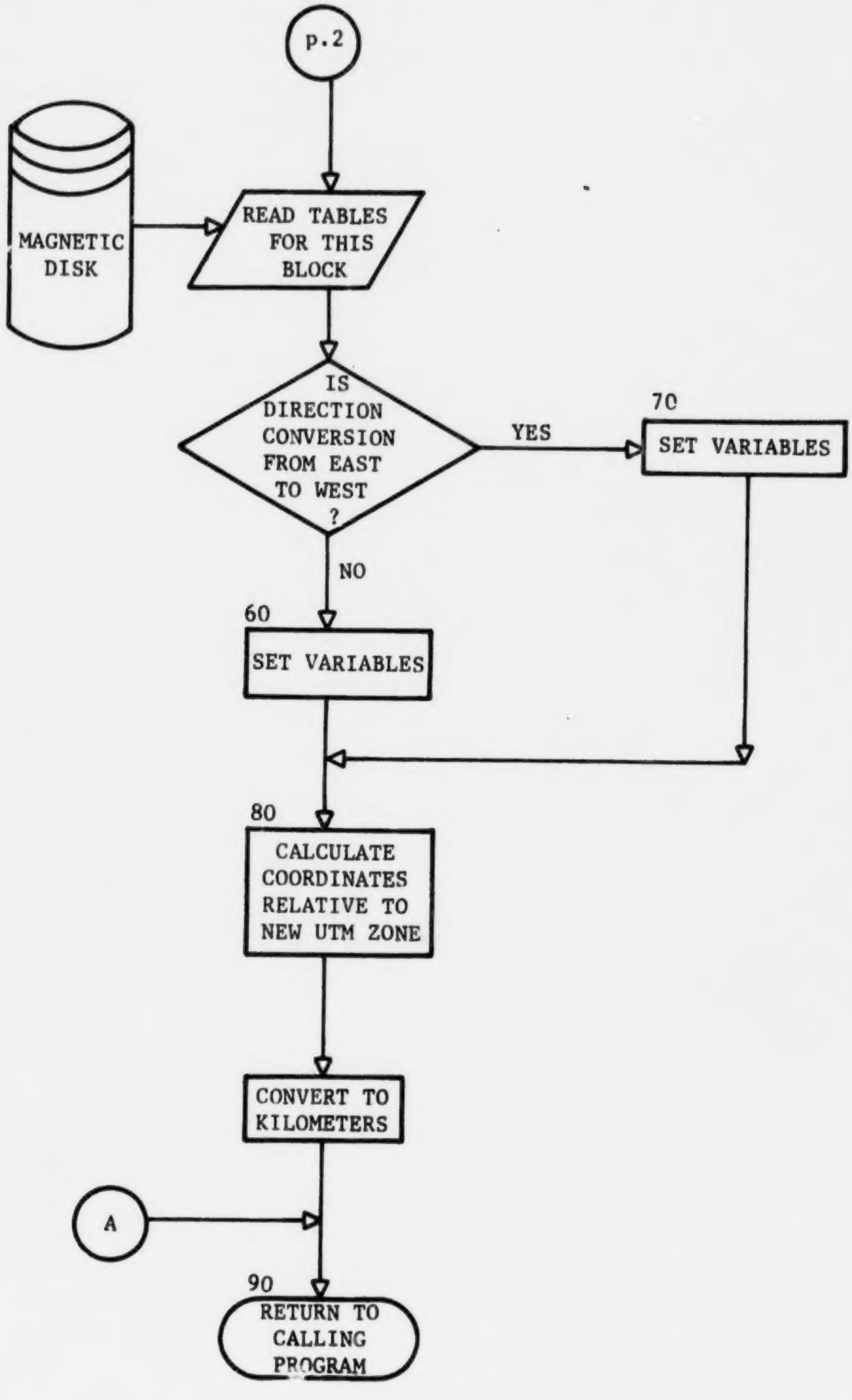
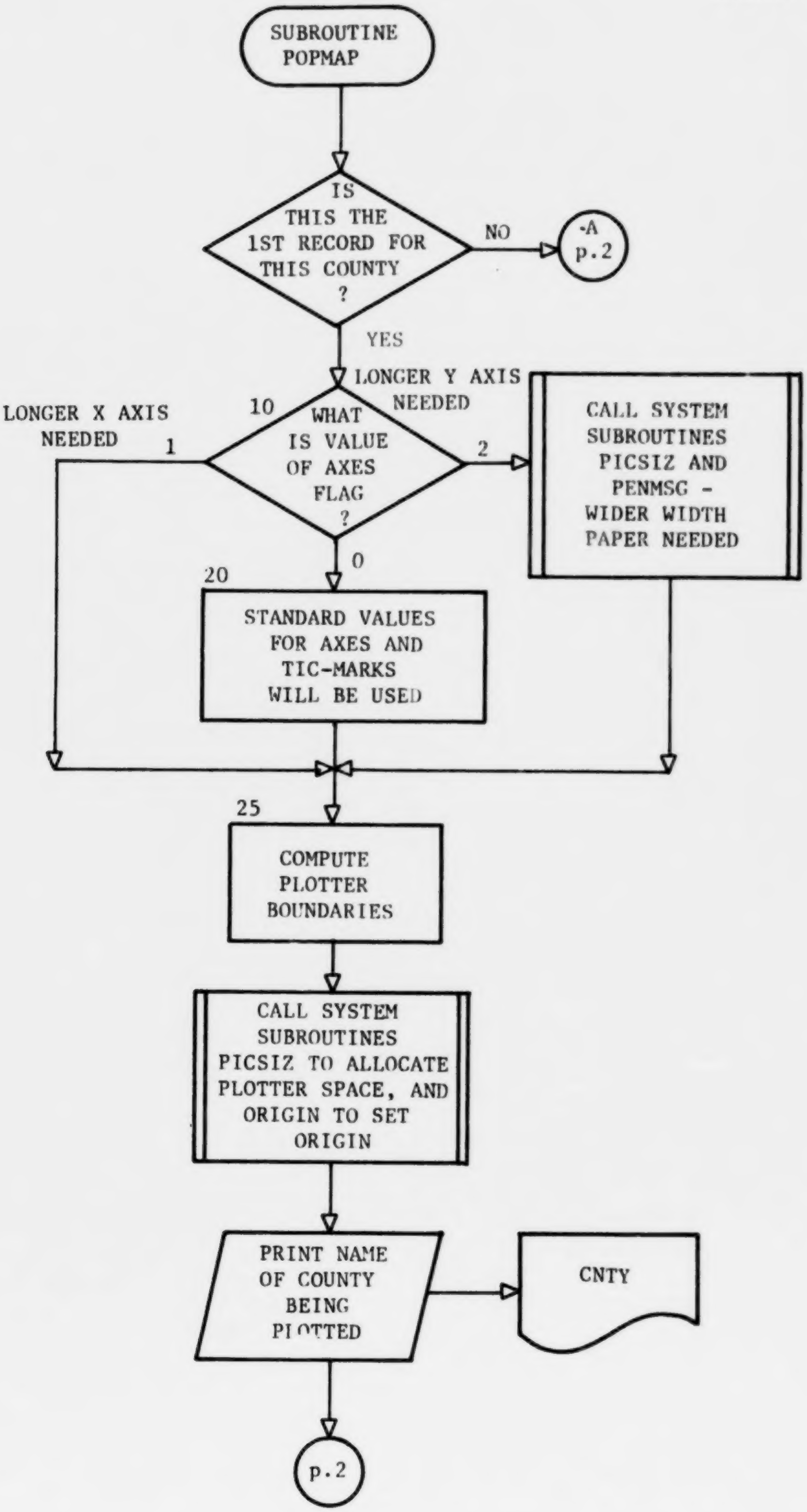
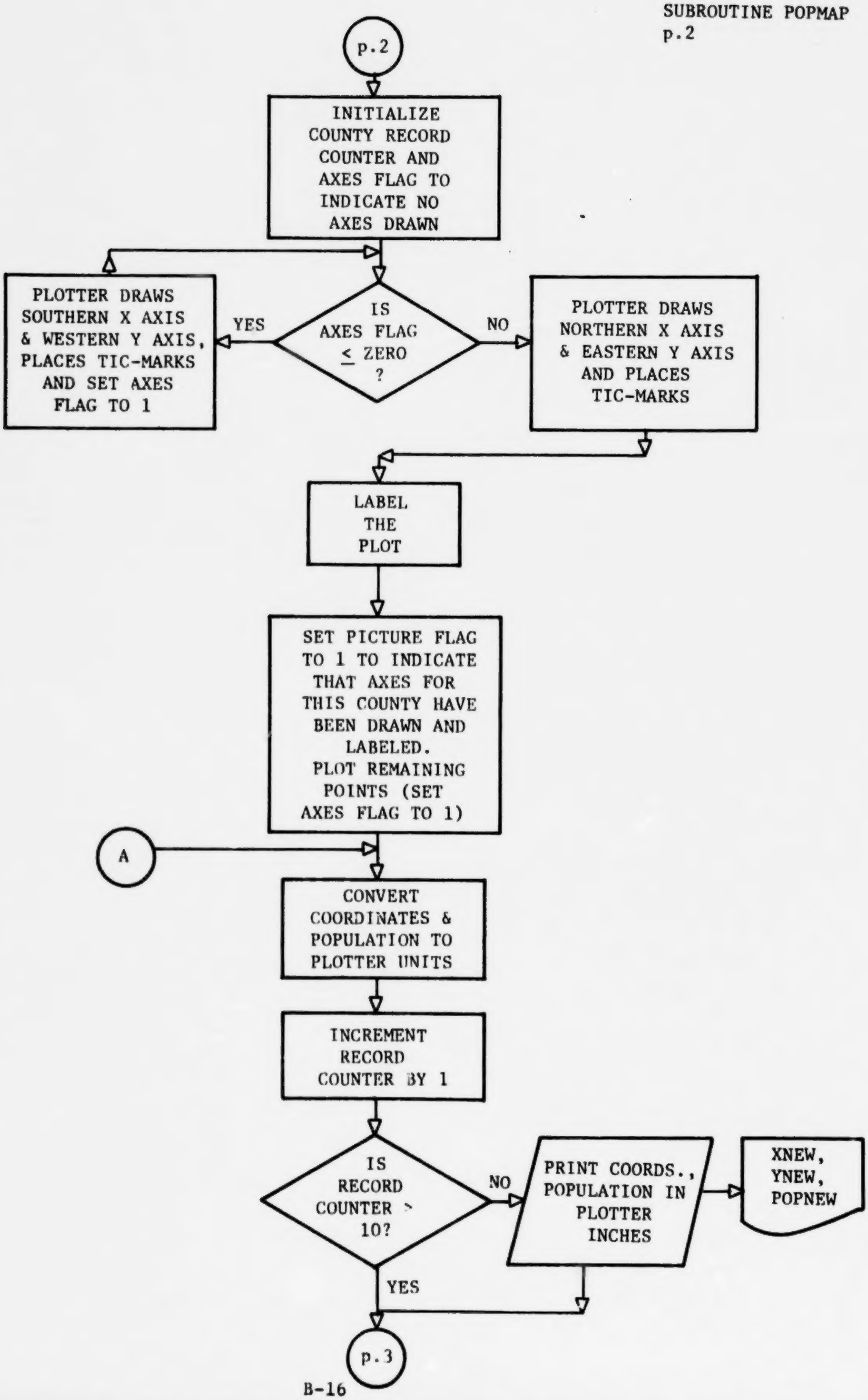
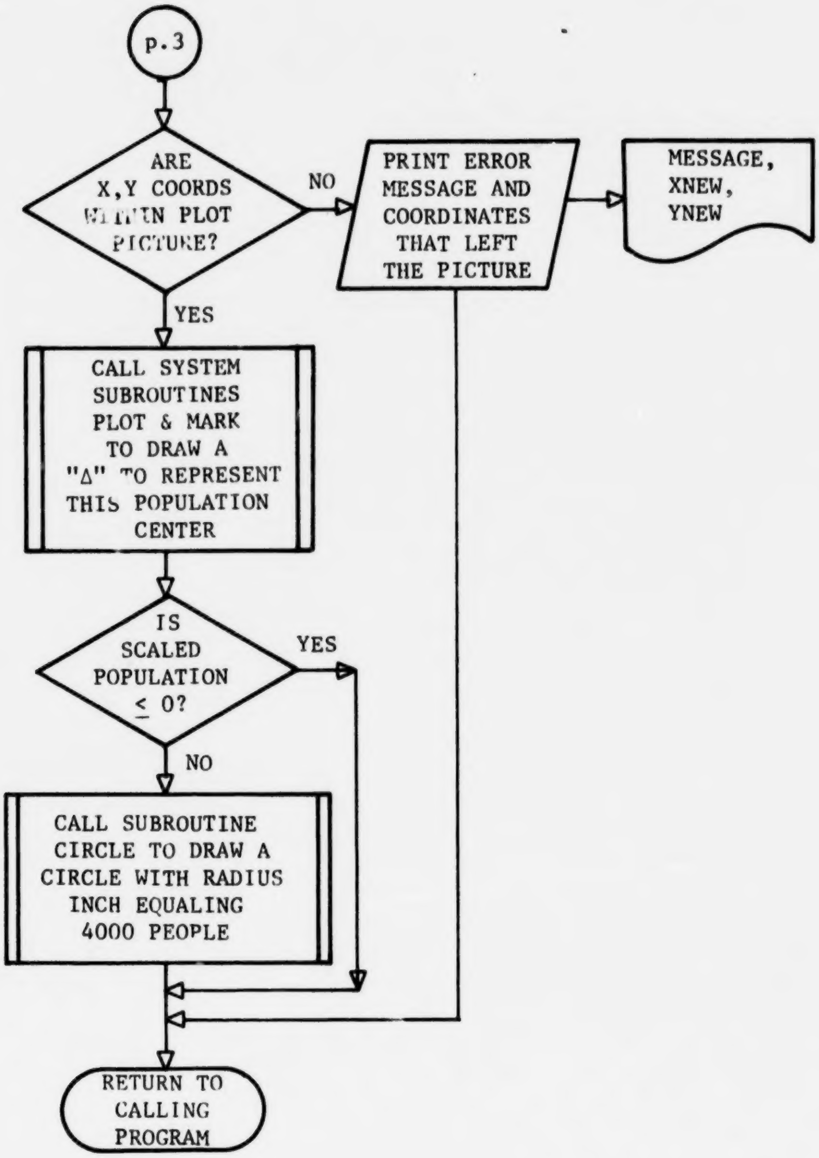
*OBTAINED FROM EPA WITHOUT DOCUMENTATION

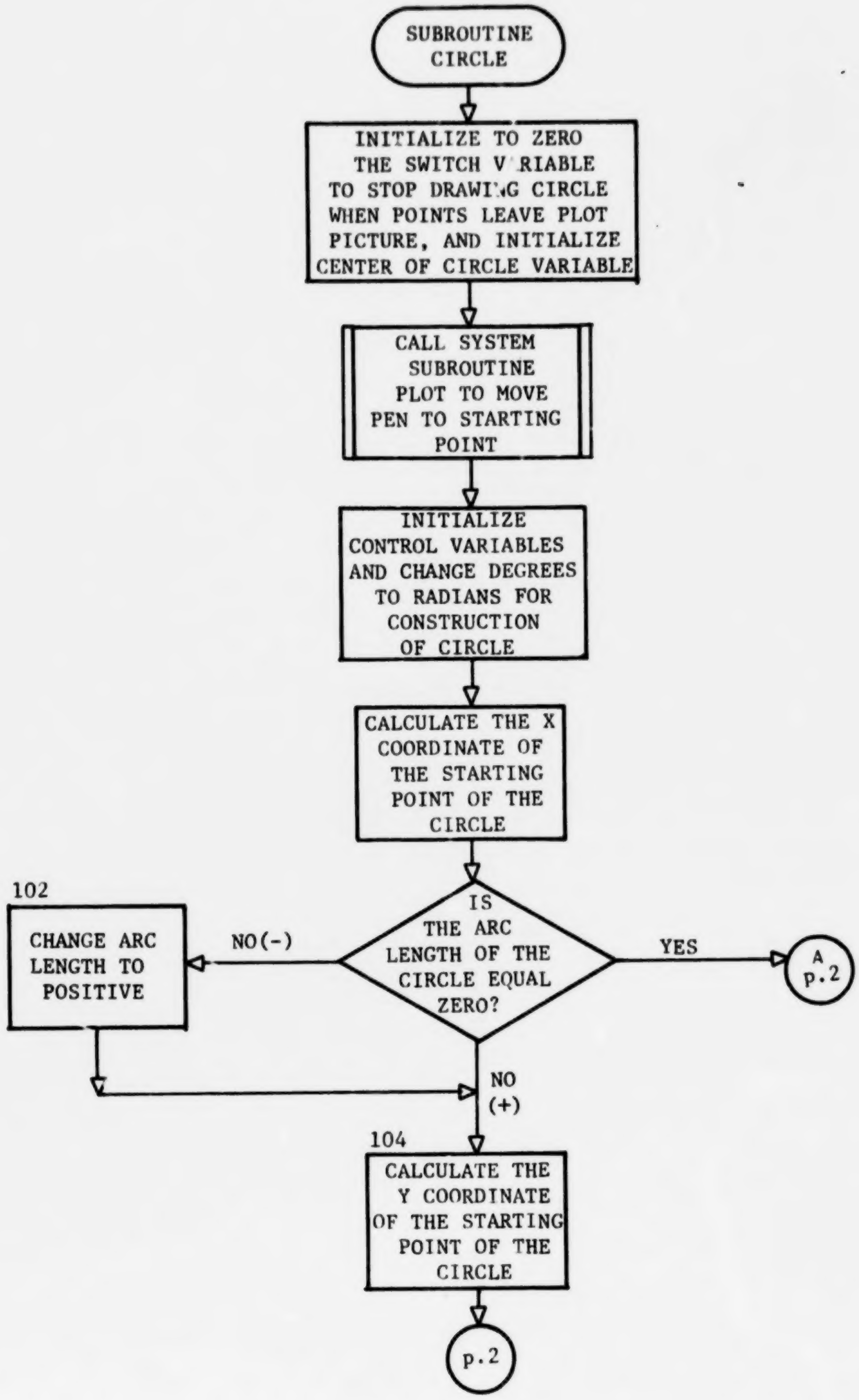

p.2
MAGNETIC DISK
READ TABLES FOR THIS BLOCK
IS DIRECTION CONVERSION FROM EAST TO WEST ?
YES
70
SET VARIABLES
NO
60
SET VARIABLES
80
CALCULATE COORDINATES RELATIVE TO NEW UTM ZONE
CONVERT TO KILOMETERS
A
90
RETURN TO CALLING PROGRAM


SUBROUTINE POPMAP
IS THIS THE 1ST RECORD FOR THIS COUNTY ?
NO
A p.2
YES
10
WHAT IS VALUE OF AXES FLAG ?
LONGER X AXIS NEEDED
1
LONGER Y AXIS NEEDED
2
CALL SYSTEM SUBROUTINES PICSIZ AND PENMSG - WIDER WIDTH PAPER NEEDED
0
20
STANDARD VALUES FOR AXES AND TIC-MARKS WILL BE USED
25
COMPUTE PLOTTER BOUNDARIES
CALL SYSTEM SUBROUTINES PICSIZ TO ALLOCATE PLOTTER SPACE, AND ORIGIN TO SET ORIGIN
PRINT NAME OF COUNTY BEING PLOTTED
CNTY
p.2

SUBROUTINE POPMAP
p.2


p.2
INITIALIZE COUNTY RECORD COUNTER AND AXES FLAG TO INDICATE NO AXES DRAWN
IS AXES FLAG ≤ ZERO ?
YES
PLOTTER DRAWS SOUTHERN X AXIS & WESTERN Y AXIS, PLACES TIC-MARKS AND SET AXES FLAG TO 1
NO
PLOTTER DRAWS NORTHERN X AXIS & EASTERN Y AXIS AND PLACES TIC-MARKS
LABEL THE PLOT
SET PICTURE FLAG TO 1 TO INDICATE THAT AXES FOR THIS COUNTY HAVE BEEN DRAWN AND LABELED. PLOT REMAINING POINTS (SET AXES FLAG TO 1)
A
CONVERT COORDINATES & POPULATION TO PLOTTER UNITS
INCREMENT RECORD COUNTER BY 1
IS RECORD COUNTER > 10?
NO
PRINT COORDS., POPULATION IN PLOTTER INCHES
XNEW, YNEW, POPNEW
YES
p.3


p.3
ARE X,Y COORDS WITHIN PLOT PICTURE?
NO
PRINT ERROR MESSAGE AND COORDINATES THAT LEFT THE PICTURE
MESSAGE, XNEW, YNEW
YES
CALL SYSTEM SUBROUTINES PLOT & MARK TO DRAW A "Δ" TO REPRESENT THIS POPULATION CENTER
IS SCALED POPULATION ≤ 0?
YES
NO
CALL SUBROUTINE CIRCLE TO DRAW A CIRCLE WITH RADIUS INCH EQUALING 4000 PEOPLE
RETURN TO CALLING PROGRAM


SUBROUTINE CIRCLE
INITIALIZE TO ZERO THE SWITCH VARIABLE TO STOP DRAWING CIRCLE WHEN POINTS LEAVE PLOT PICTURE, AND INITIALIZE CENTER OF CIRCLE VARIABLE
CALL SYSTEM SUBROUTINE PLOT TO MOVE PEN TO STARTING POINT
INITIALIZE CONTROL VARIABLES AND CHANGE DEGREES TO RADIANS FOR CONSTRUCTION OF CIRCLE
CALCULATE THE X COORDINATE OF THE STARTING POINT OF THE CIRCLE
IS THE ARC LENGTH OF THE CIRCLE EQUAL ZERO?
YES
A p.2
NO(-)
102
CHANGE ARC LENGTH TO POSITIVE
NO (+)
104
CALCULATE THE Y COORDINATE OF THE STARTING POINT OF THE CIRCLE
p.2

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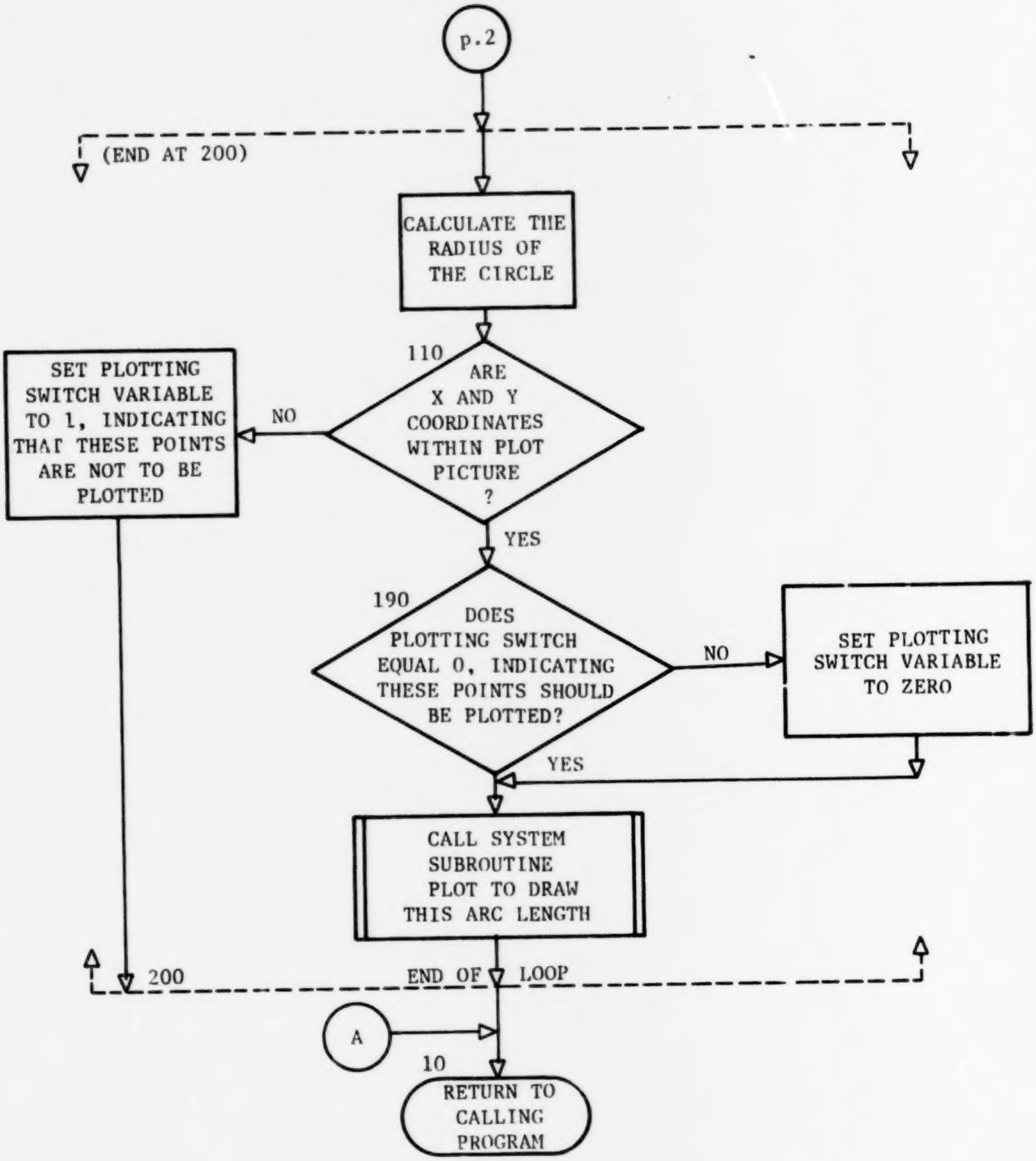
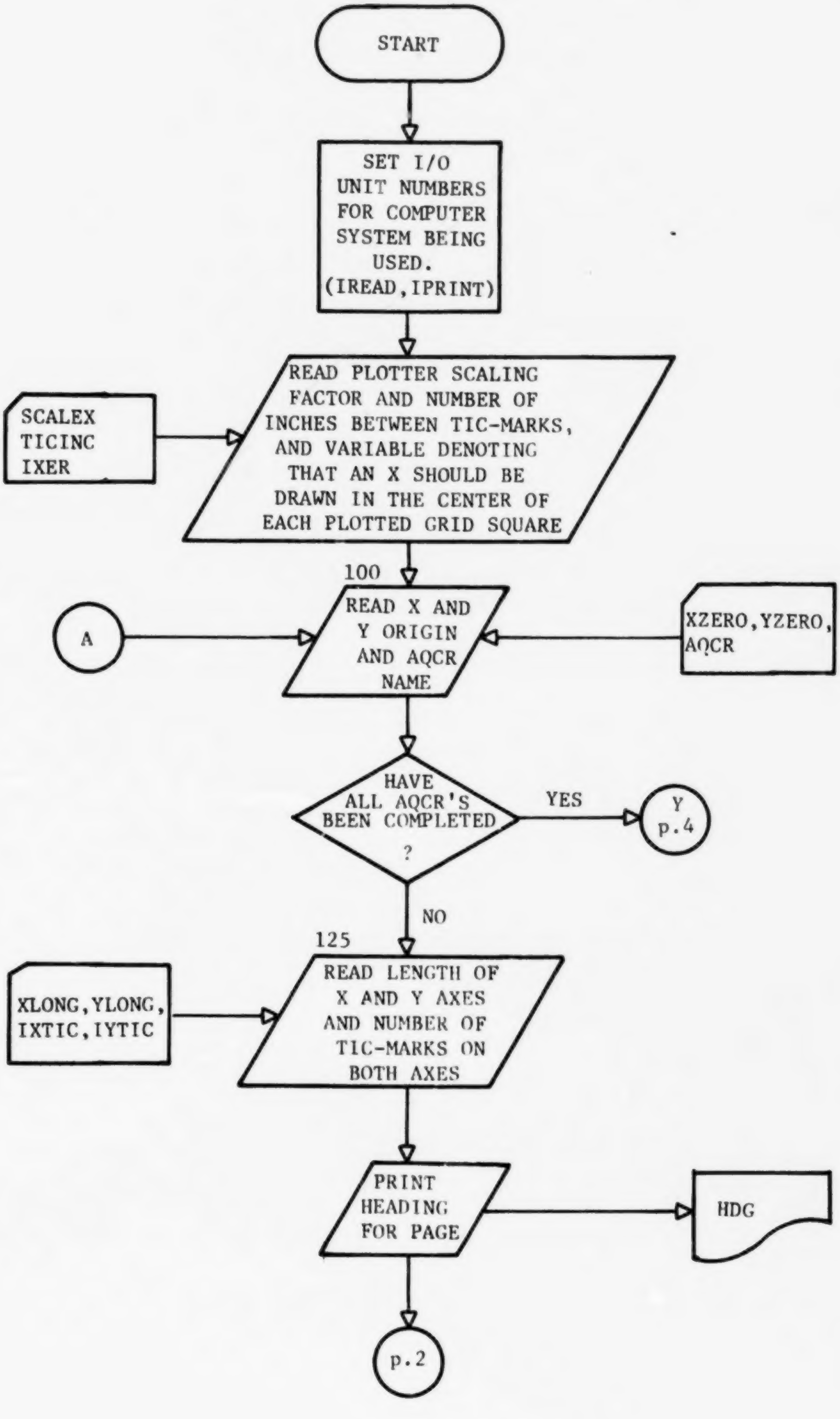

p.2
(END AT 200)
CALCULATE THE RADIUS OF THE CIRCLE
110
ARE X AND Y COORDINATES WITHIN PLOT PICTURE ?
NO
SET PLOTTING SWITCH VARIABLE TO 1, INDICATING THAT THESE POINTS ARE NOT TO BE PLOTTED
YES
190
DOES PLOTTING SWITCH EQUAL 0, INDICATING THESE POINTS SHOULD BE PLOTTED?
NO
SET PLOTTING SWITCH VARIABLE TO ZERO
YES
CALL SYSTEM SUBROUTINE PLOT TO DRAW THIS ARC LENGTH
200
END OF LOOP
A
10
RETURN TO CALLING PROGRAM

APPENDIX C

LOGICAL FLOW CHARTS — CAASE3 (and Subroutines)


START
SET I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED. (IREAD,IPRINT)
SCALEX TICINC IXER
READ PLOTTER SCALING FACTOR AND NUMBER OF INCHES BETWEEN TIC-MARKS, AND VARIABLE DENOTING THAT AN X SHOULD BE DRAWN IN THE CENTER OF EACH PLOTTED GRID SQUARE
100
A
READ X AND Y ORIGIN AND AQCR NAME
XZERO,YZERO, AQCR
HAVE ALL AQCR'S BEEN COMPLETED ?
YES
Y p.4
NO
125
XLONG,YLONG, IXTIC,IYTIC
READ LENGTH OF X AND Y AXES AND NUMBER OF TIC-MARKS ON BOTH AXES
PRINT HEADING FOR PAGE
HDG
p.2

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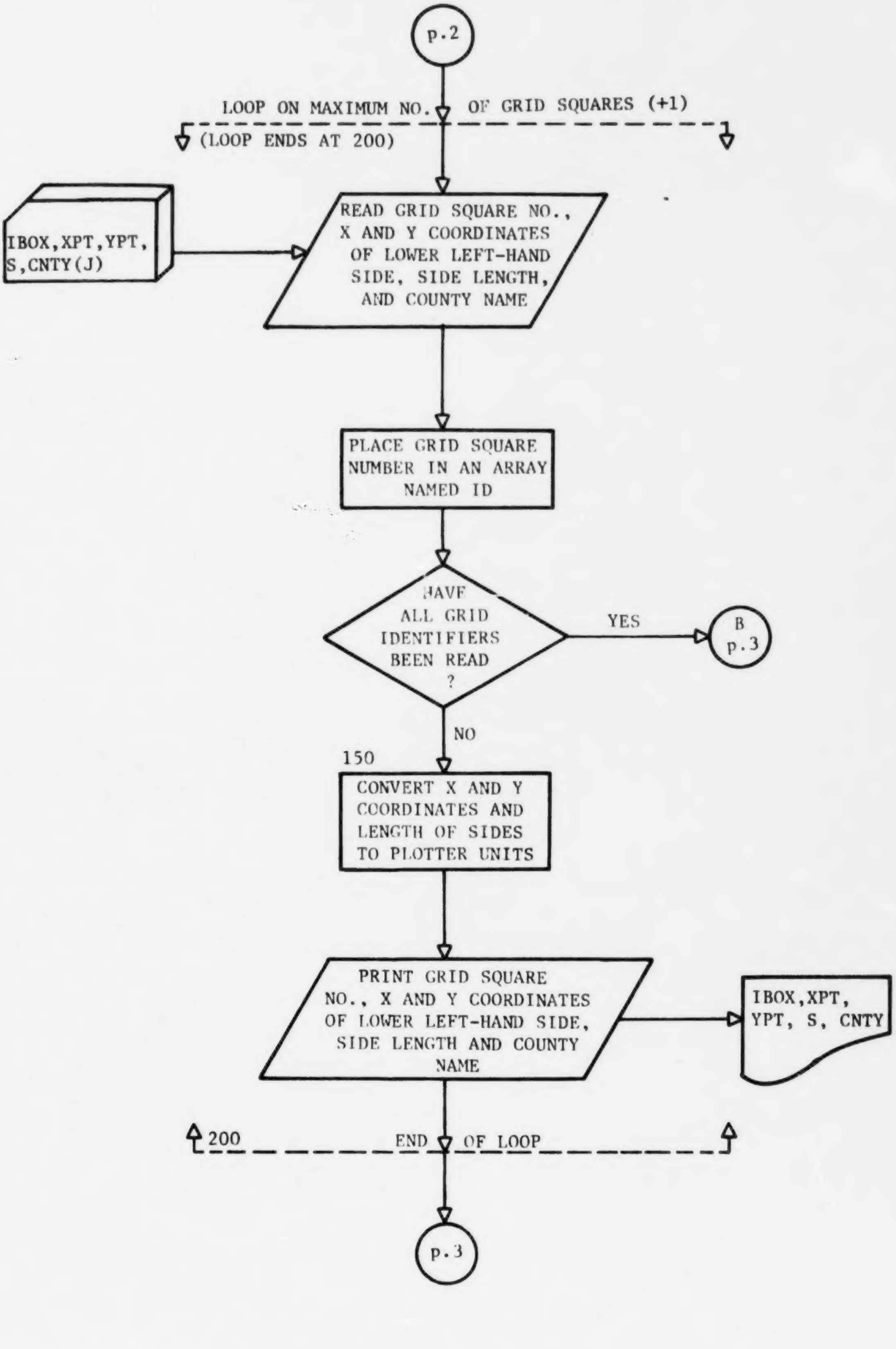
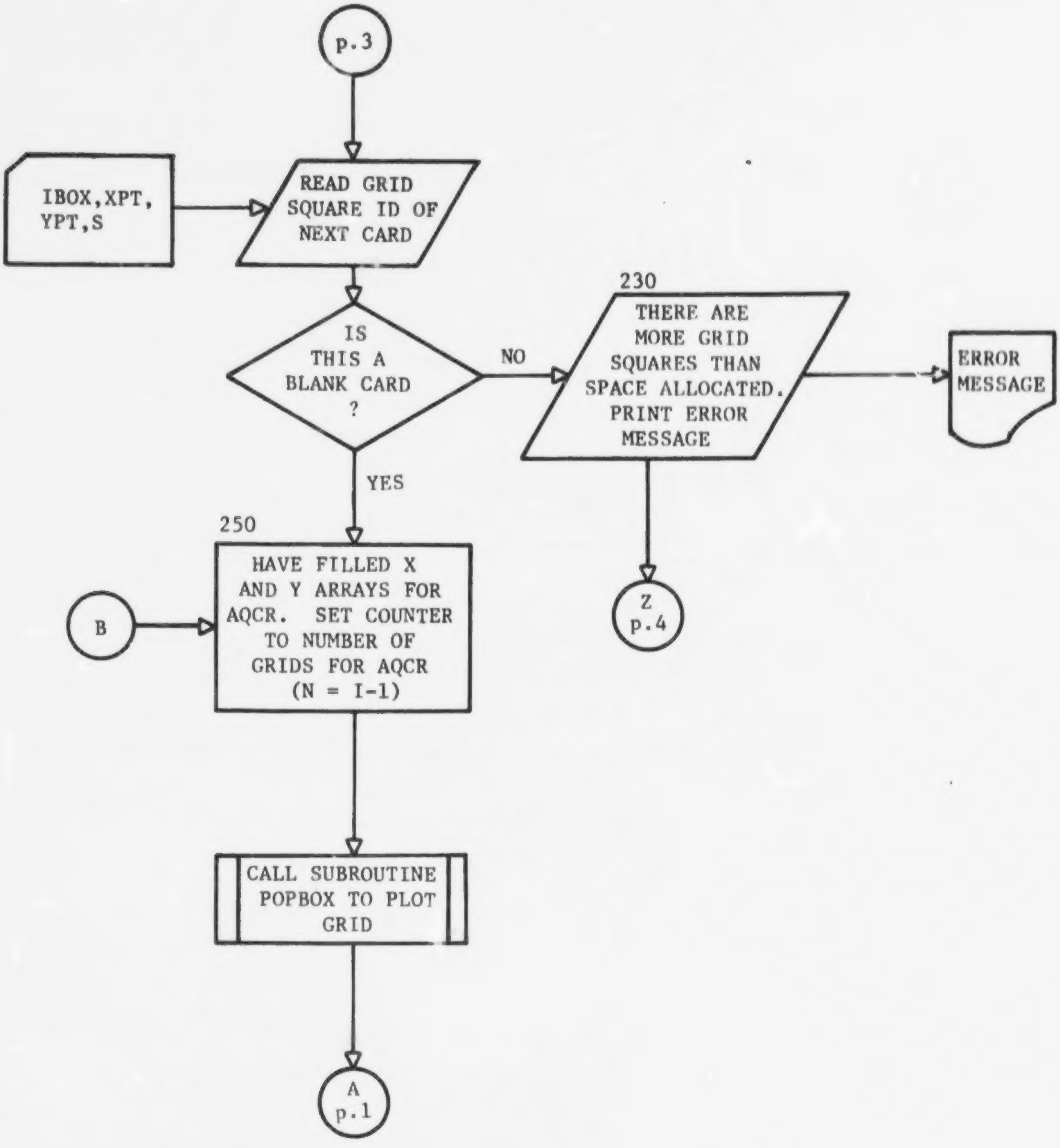
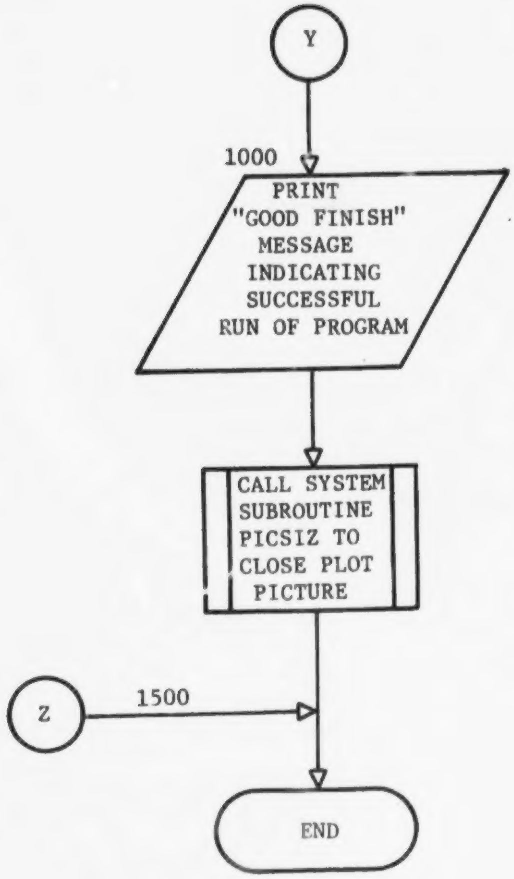
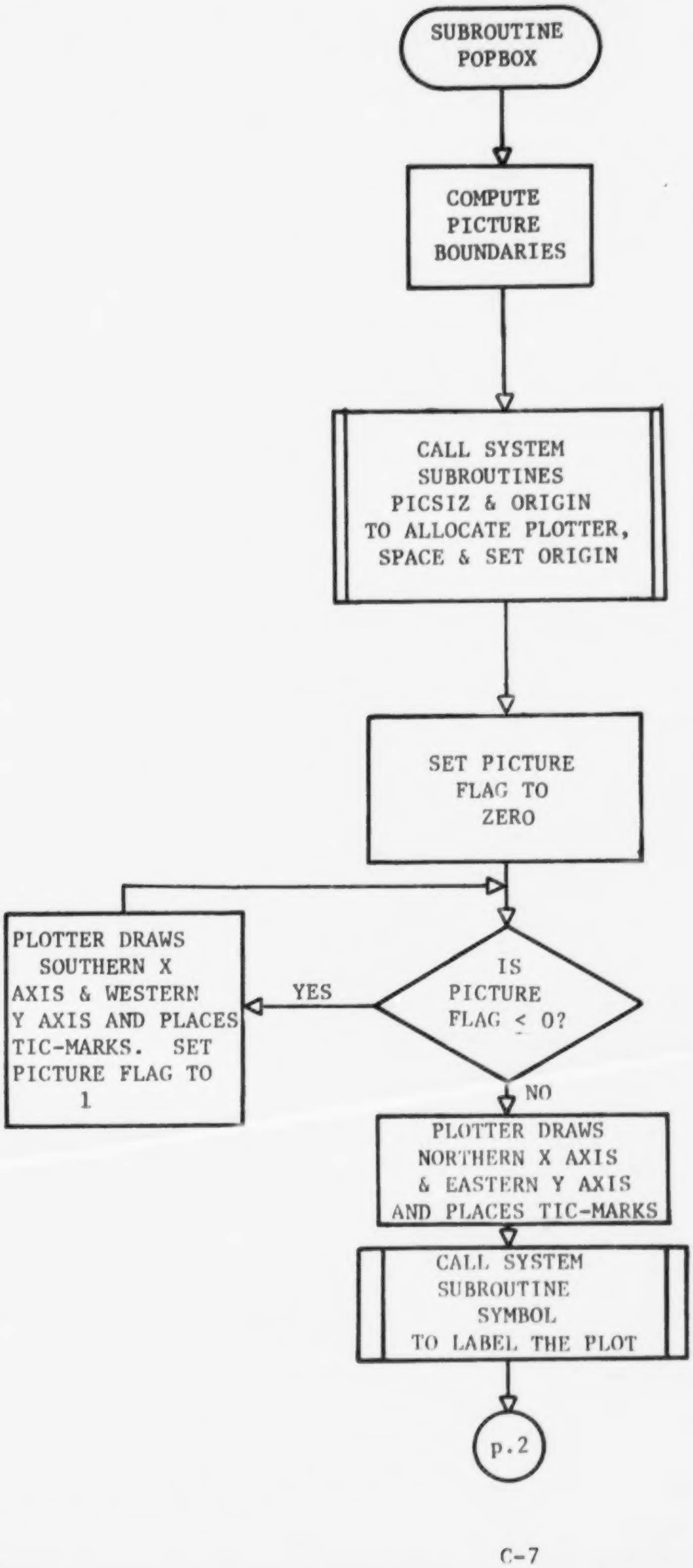
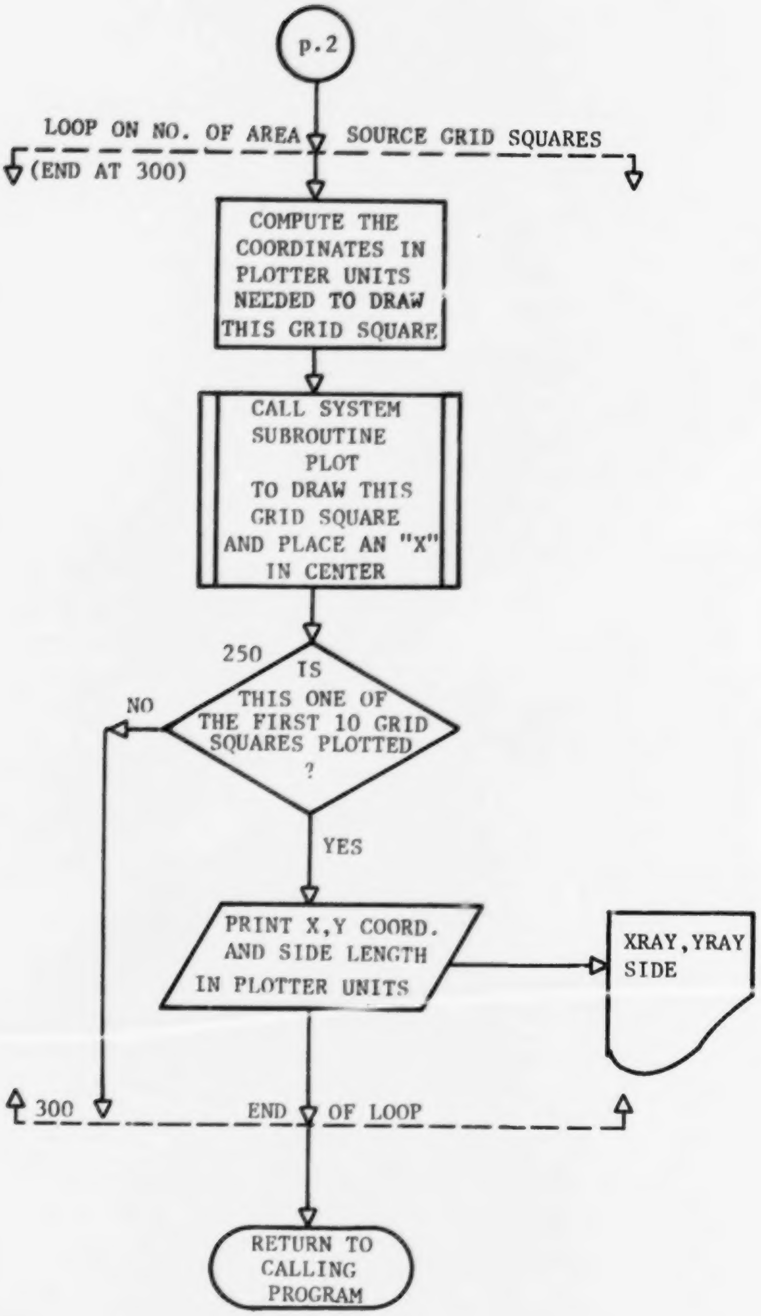

p.2
LOOP ON MAXIMUM NO. OF GRID SQUARES (+1)
(LOOP ENDS AT 200)
IBOX,XPT,YPT,
S,CNTY(J)
READ GRID SQUARE NO., X AND Y COORDINATES OF LOWER LEFT-HAND SIDE, SIDE LENGTH, AND COUNTY NAME
PLACE GRID SQUARE NUMBER IN AN ARRAY NAMED ID
HAVE ALL GRID IDENTIFIERS BEEN READ ?
YES
B
p.3
NO
150
CONVERT X AND Y COORDINATES AND LENGTH OF SIDES TO PLOTTER UNITS
PRINT GRID SQUARE NO., X AND Y COORDINATES OF LOWER LEFT-HAND SIDE, SIDE LENGTH AND COUNTY NAME
IBOX,XPT,
YPT, S, CNTY
200
END OF LOOP
p.3


p.3
IBOX,XPT,
YPT,S
READ GRID
SQUARE ID OF
NEXT CARD
IS
THIS A
BLANK CARD
?
NO
230
THERE ARE
MORE GRID
SQUARES THAN
SPACE ALLOCATED.
PRINT ERROR
MESSAGE
ERROR
MESSAGE
YES
250
HAVE FILLED X
AND Y ARRAYS FOR
AQCR. SET COUNTER
TO NUMBER OF
GRIDS FOR AQCR
(N = I-1)
B
Z
p.4
CALL SUBROUTINE
POPBOX TO PLOT
GRID
A
p.1

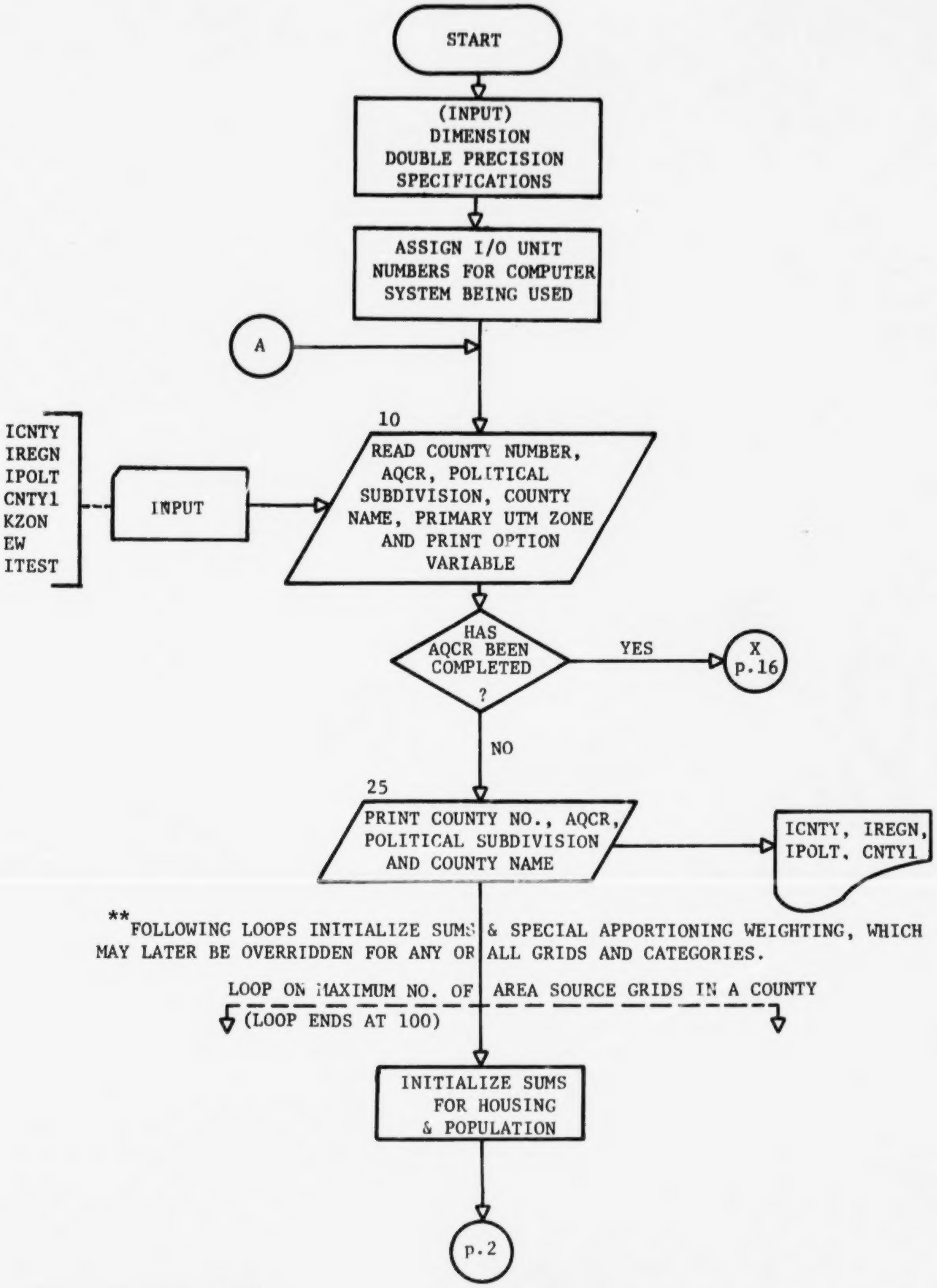

Y
1000
PRINT "GOOD FINISH" MESSAGE INDICATING SUCCESSFUL RUN OF PROGRAM
CALL SYSTEM SUBROUTINE PICSIZ TO CLOSE PLOT PICTURE
Z
1500
END


SUBROUTINE POPBOX
COMPUTE PICTURE BOUNDARIES
CALL SYSTEM SUBROUTINES PICSIZ & ORIGIN TO ALLOCATE PLOTTER, SPACE & SET ORIGIN
SET PICTURE FLAG TO ZERO
IS PICTURE FLAG ≤ 0?
YES
PLOTTER DRAWS SOUTHERN X AXIS & WESTERN Y AXIS AND PLACES TIC-MARKS. SET PICTURE FLAG TO 1
NO
PLOTTER DRAWS NORTHERN X AXIS & EASTERN Y AXIS AND PLACES TIC-MARKS
CALL SYSTEM SUBROUTINE SYMBOL TO LABEL THE PLOT
p.2


p.2
LOOP ON NO. OF AREA SOURCE GRID SQUARES
(END AT 300)
COMPUTE THE COORDINATES IN PLOTTER UNITS NEEDED TO DRAW THIS GRID SQUARE
CALL SYSTEM SUBROUTINE PLOT TO DRAW THIS GRID SQUARE AND PLACE AN "X" IN CENTER
250
IS THIS ONE OF THE FIRST 10 GRID SQUARES PLOTTED ?
NO
YES
PRINT X,Y COORD. AND SIDE LENGTH IN PLOTTER UNITS
XRAY, YRAY SIDE
300
END OF LOOP
RETURN TO CALLING PROGRAM

APPENDIX D

LOGICAL FLOW CHARTS — CAASE4 (and Subroutines)


START
(INPUT)
DIMENSION
DOUBLE PRECISION
SPECIFICATIONS
ASSIGN I/O UNIT
NUMBERS FOR COMPUTER
SYSTEM BEING USED
A
10
ICNTY
IREGN
IPOLT
CNTY1
KZON
EW
ITEST
INPUT
READ COUNTY NUMBER,
AQCR, POLITICAL
SUBDIVISION, COUNTY
NAME, PRIMARY UTM ZONE
AND PRINT OPTION
VARIABLE
HAS
AQCR BEEN
COMPLETED
?
YES
X
p.16
NO
25
PRINT COUNTY NO., AQCR,
POLITICAL SUBDIVISION
AND COUNTY NAME
ICNTY, IREGN,
IPOLT, CNTY1
**FOLLOWING LOOPS INITIALIZE SUMS & SPECIAL APPORTIONING WEIGHTING, WHICH
MAY LATER BE OVERRIDDEN FOR ANY OR ALL GRIDS AND CATEGORIES.
LOOP ON MAXIMUM NO. OF AREA SOURCE GRIDS IN A COUNTY
(LOOP ENDS AT 100)
INITIALIZE SUMS
FOR HOUSING
& POPULATION
p.2

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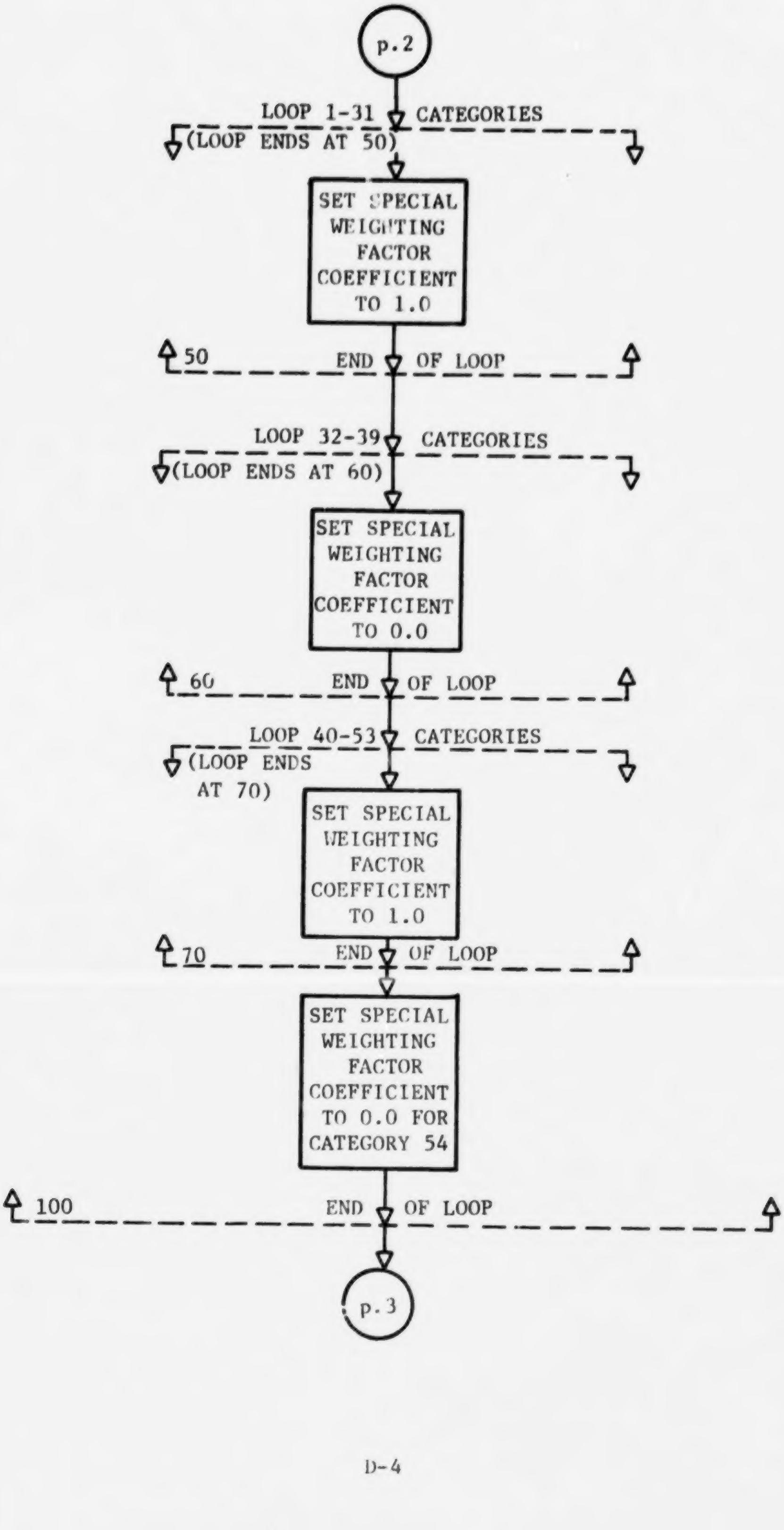
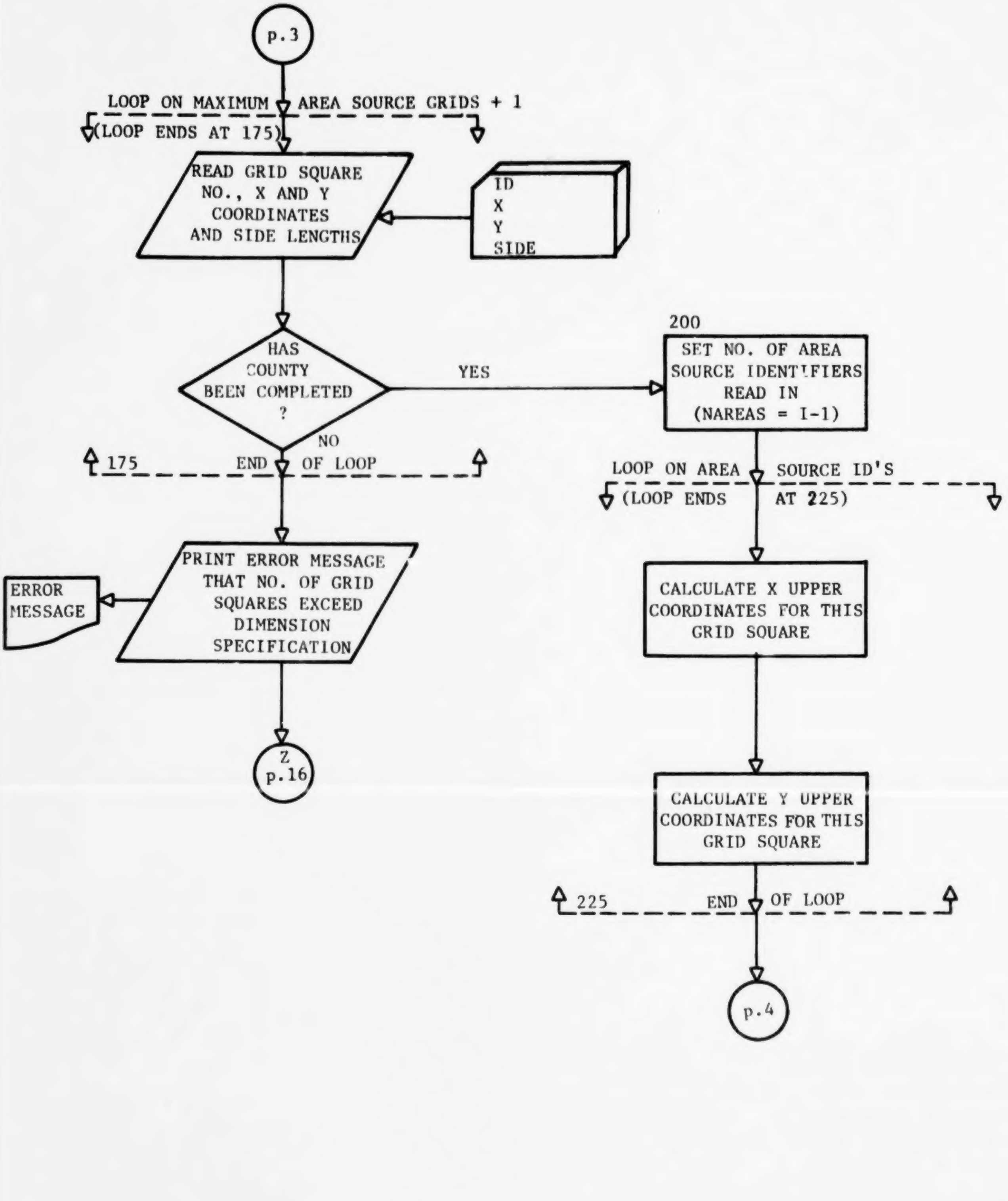
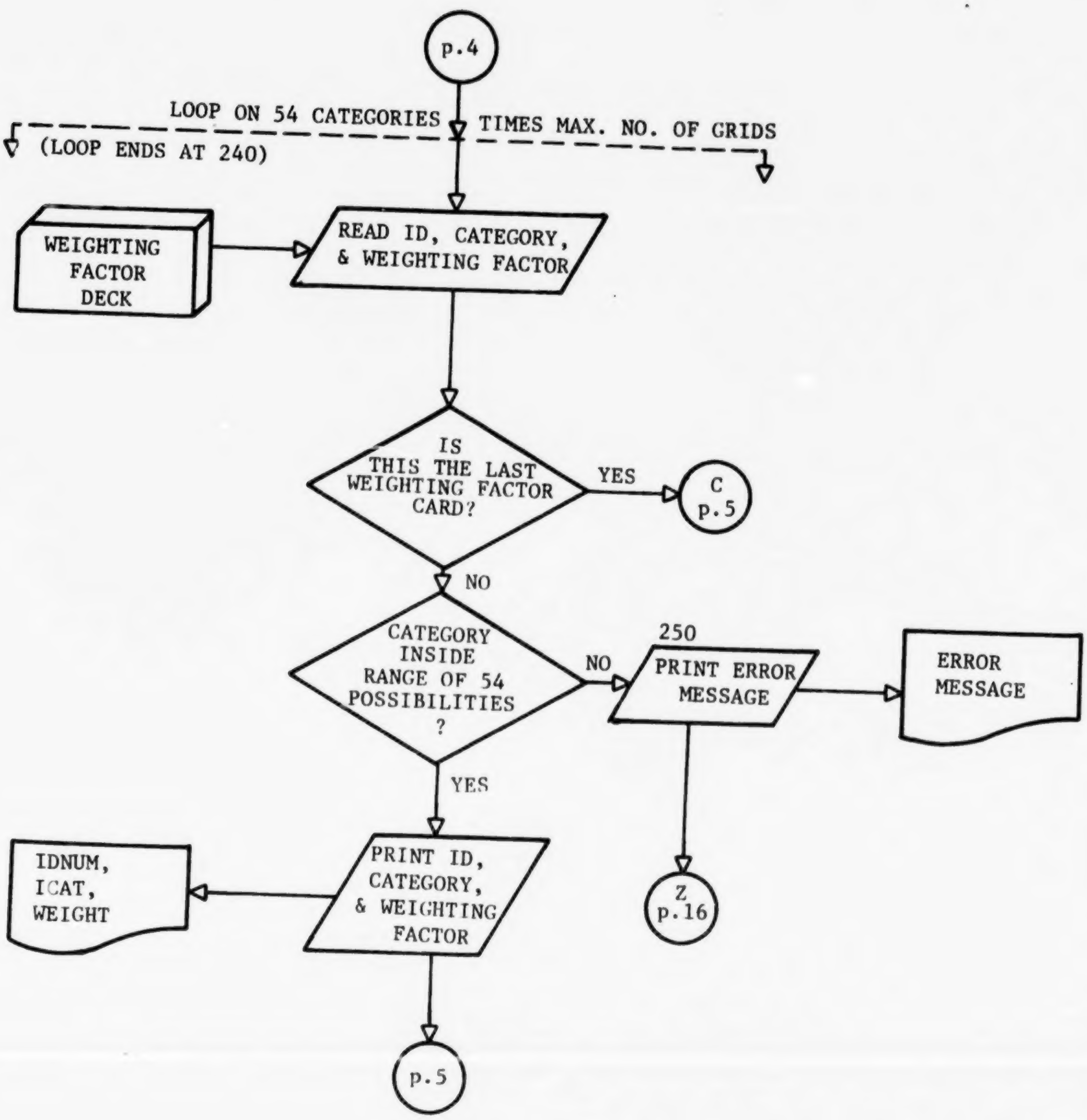
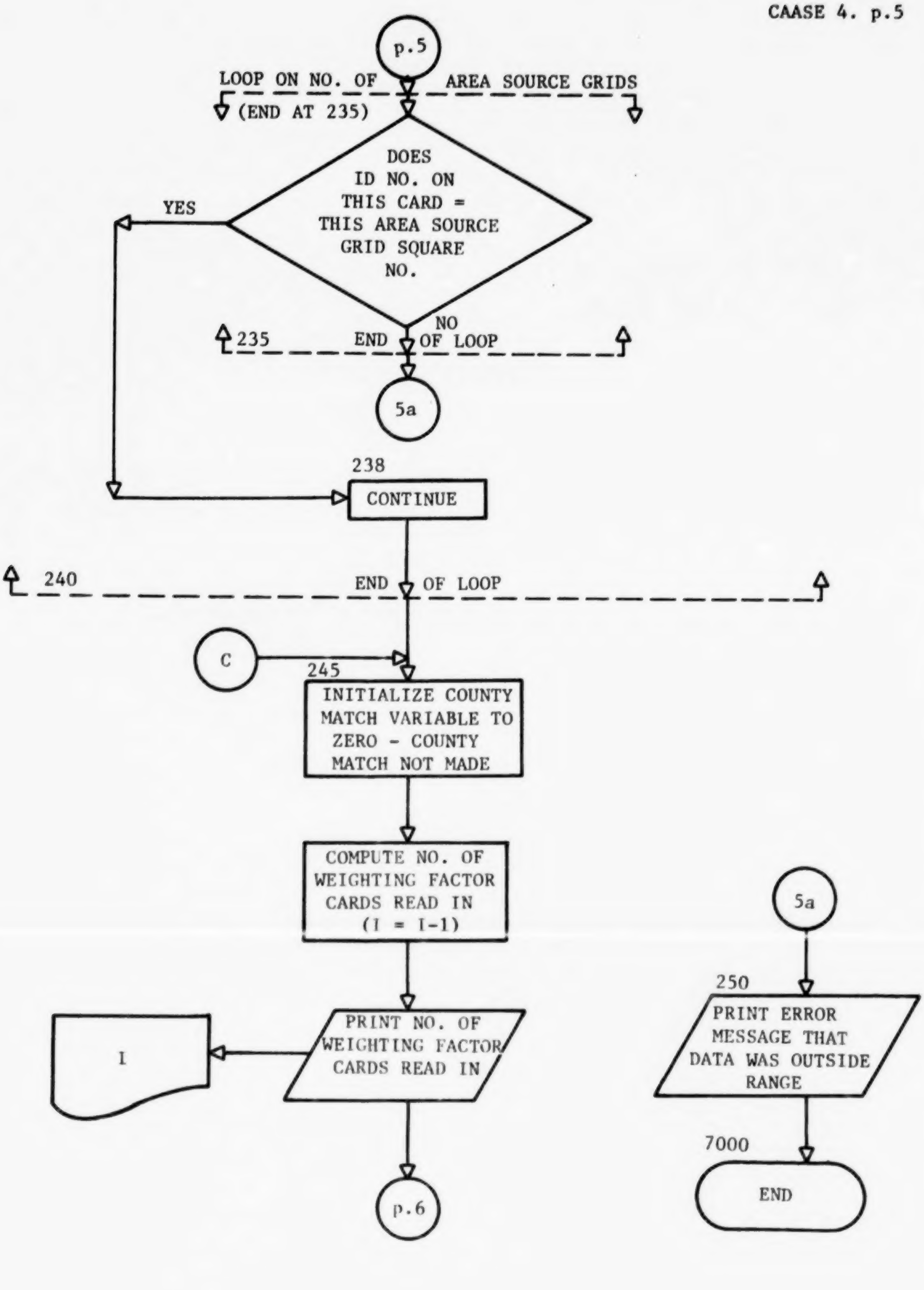
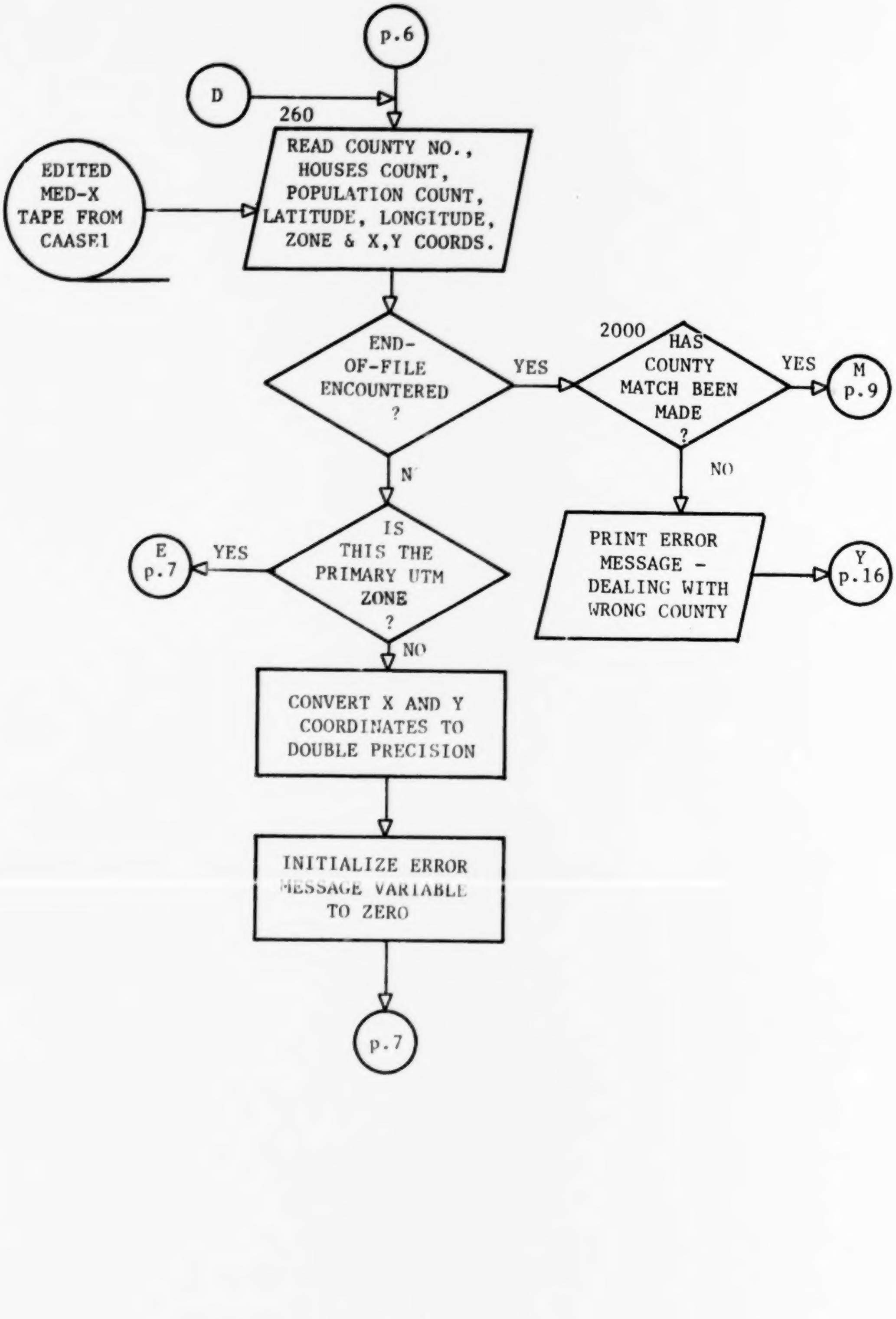
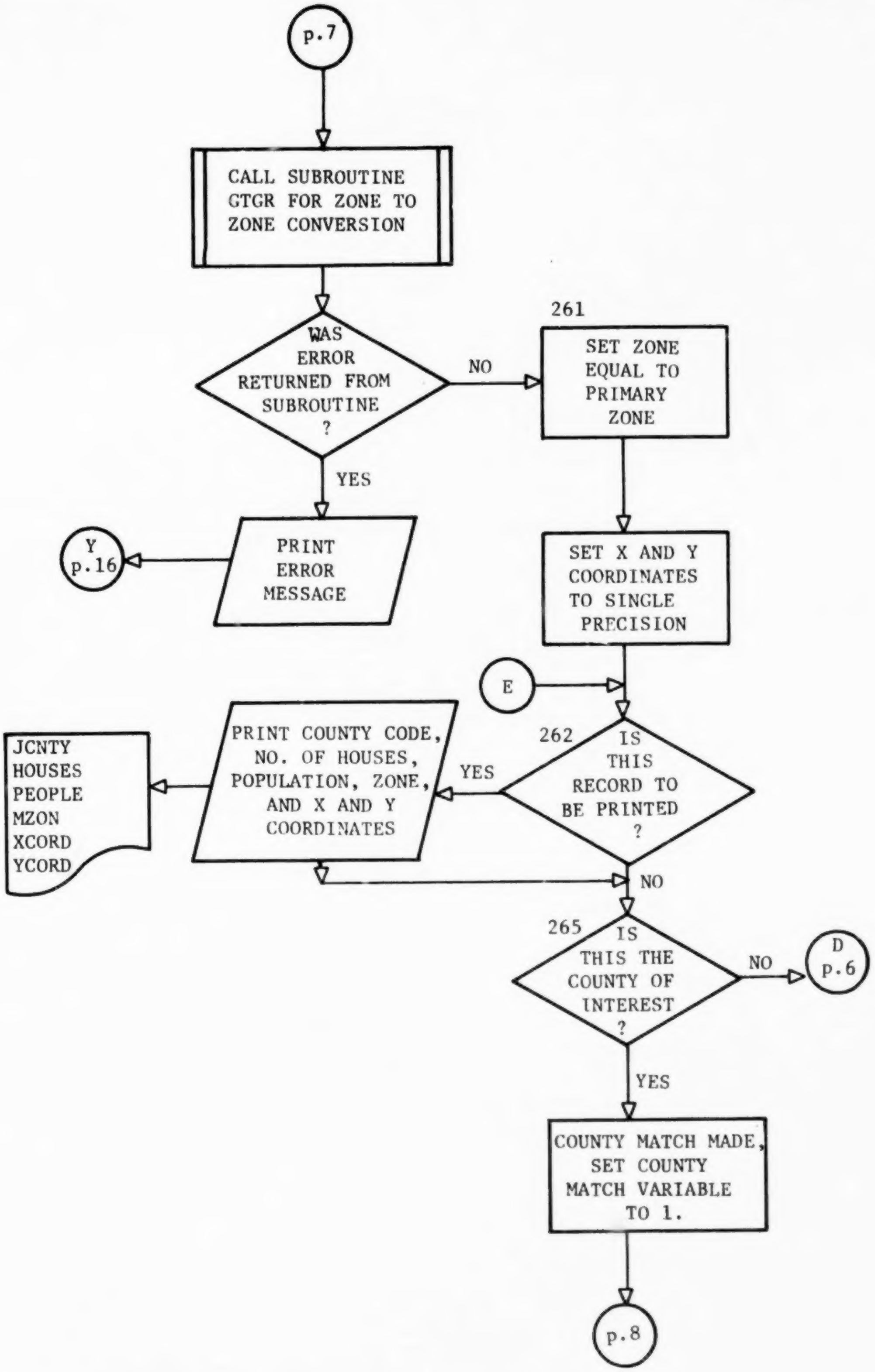

p.2
LOOP 1-31 CATEGORIES
(LOOP ENDS AT 50)
SET SPECIAL WEIGHTING FACTOR COEFFICIENT TO 1.0
50 END OF LOOP
LOOP 32-39 CATEGORIES
(LOOP ENDS AT 60)
SET SPECIAL WEIGHTING FACTOR COEFFICIENT TO 0.0
60 END OF LOOP
LOOP 40-53 CATEGORIES
(LOOP ENDS AT 70)
SET SPECIAL WEIGHTING FACTOR COEFFICIENT TO 1.0
70 END OF LOOP
SET SPECIAL WEIGHTING FACTOR COEFFICIENT TO 0.0 FOR CATEGORY 54
100 END OF LOOP
p.3

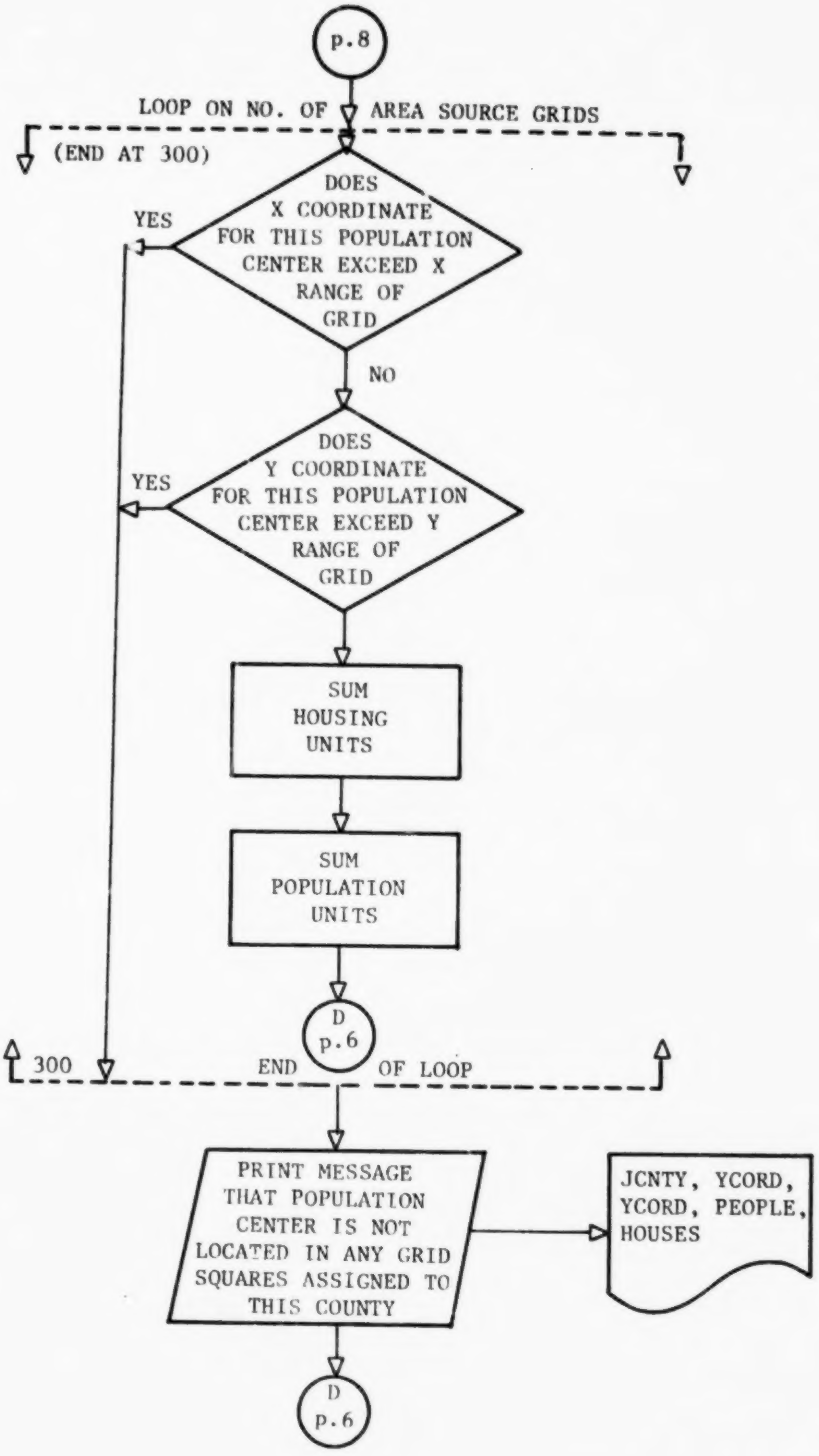

p.3
LOOP ON MAXIMUM AREA SOURCE GRIDS + 1
(LOOP ENDS AT 175)
READ GRID SQUARE NO., X AND Y COORDINATES AND SIDE LENGTHS
ID
X
Y
SIDE
HAS COUNTY BEEN COMPLETED ?
YES
NO
175 END OF LOOP
PRINT ERROR MESSAGE THAT NO. OF GRID SQUARES EXCEED DIMENSION SPECIFICATION
ERROR MESSAGE
Z
p.16
200
SET NO. OF AREA SOURCE IDENTIFIERS READ IN (NAREAS = I-1)
LOOP ON AREA SOURCE ID'S
(LOOP ENDS AT 225)
CALCULATE X UPPER COORDINATES FOR THIS GRID SQUARE
CALCULATE Y UPPER COORDINATES FOR THIS GRID SQUARE
225 END OF LOOP
p.4

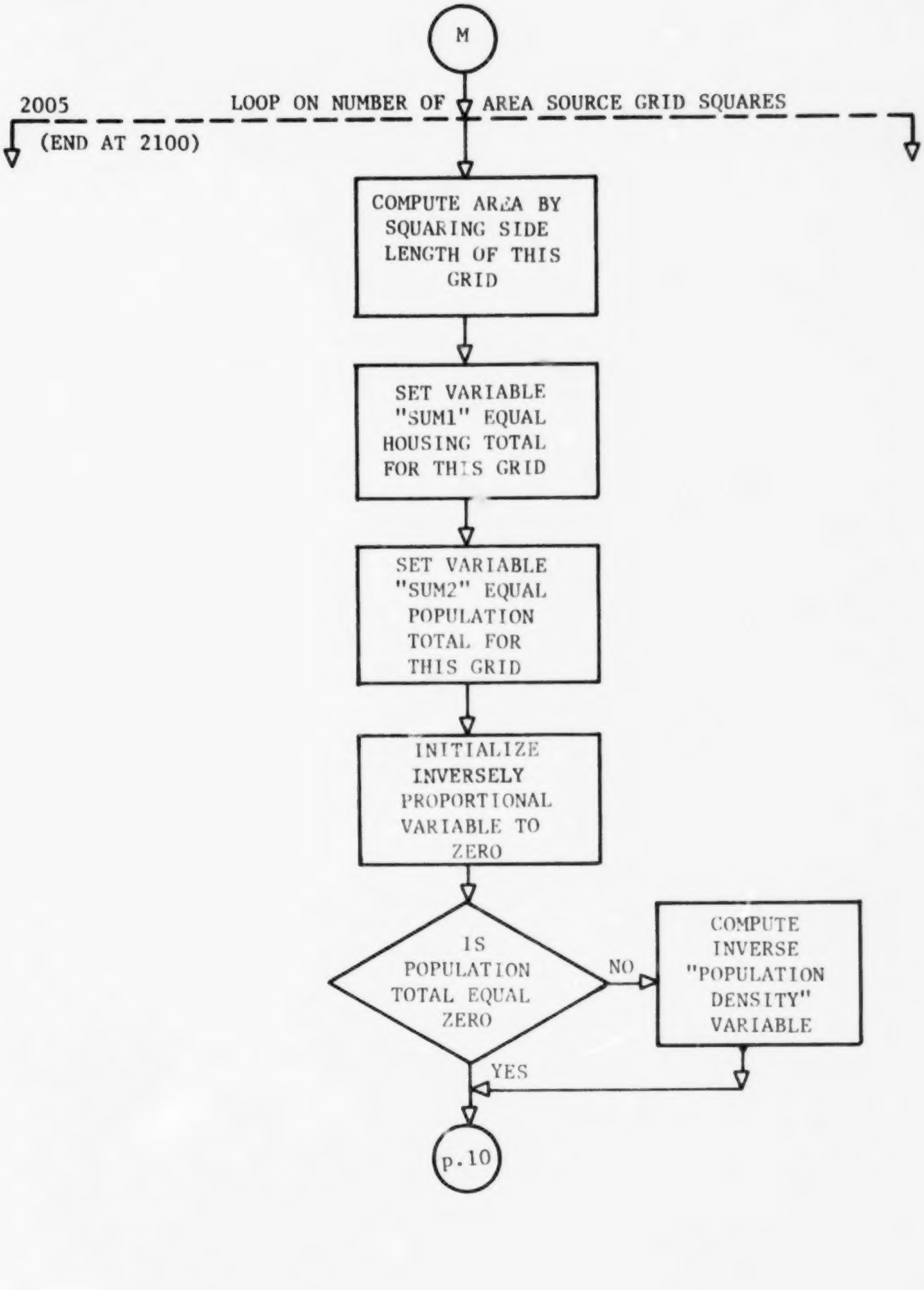

p.4
LOOP ON 54 CATEGORIES TIMES MAX. NO. OF GRIDS
(LOOP ENDS AT 240)
WEIGHTING FACTOR DECK
READ ID, CATEGORY, & WEIGHTING FACTOR
IS THIS THE LAST WEIGHTING FACTOR CARD?
YES
C p.5
NO
CATEGORY INSIDE RANGE OF 54 POSSIBILITIES ?
NO
250
PRINT ERROR MESSAGE
ERROR MESSAGE
YES
PRINT ID, CATEGORY, & WEIGHTING FACTOR
IDNUM, ICAT, WEIGHT
Z p.16
p.5

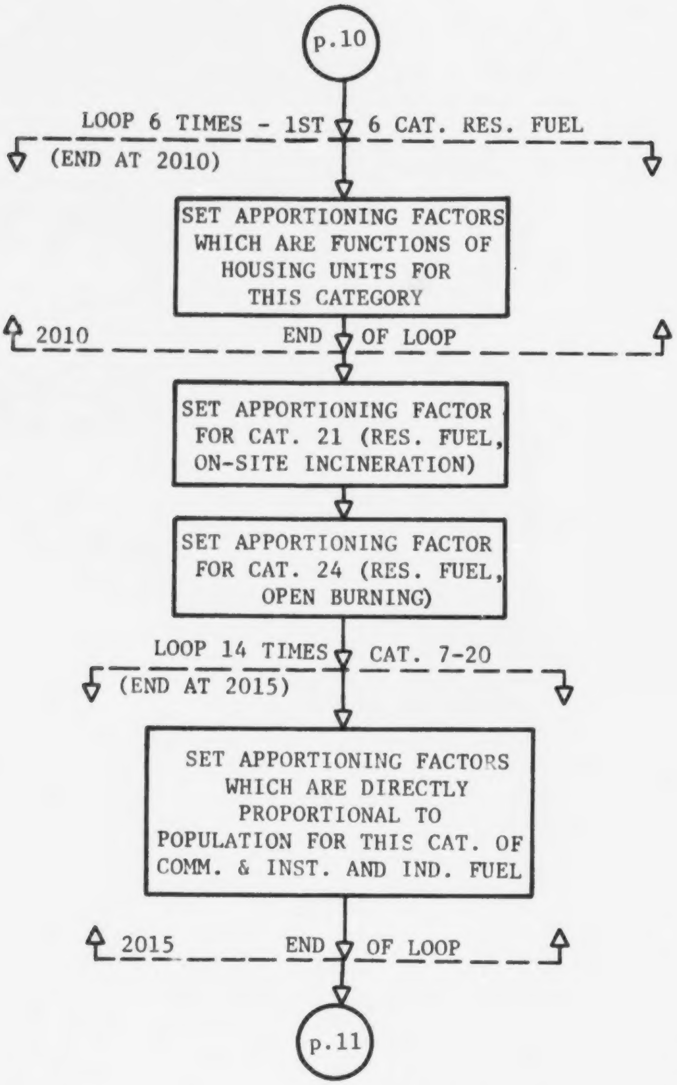

p.5
LOOP ON NO. OF AREA SOURCE GRIDS
(END AT 235)
DOES ID NO. ON THIS CARD = THIS AREA SOURCE GRID SQUARE NO.
YES
NO
235
END OF LOOP
5a
238
CONTINUE
240
END OF LOOP
C
245
INITIALIZE COUNTY MATCH VARIABLE TO ZERO - COUNTY MATCH NOT MADE
COMPUTE NO. OF WEIGHTING FACTOR CARDS READ IN (I = I-1)
I
PRINT NO. OF WEIGHTING FACTOR CARDS READ IN
p.6
5a
250
PRINT ERROR MESSAGE THAT DATA WAS OUTSIDE RANGE
7000
END

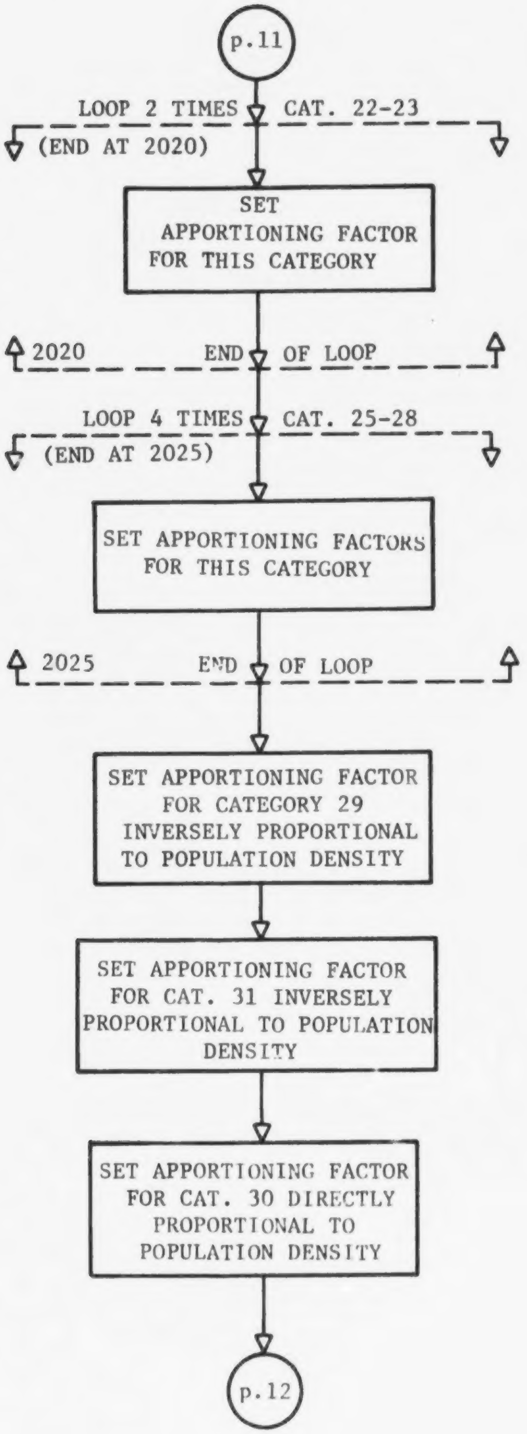

p.6
D
260
EDITED MED-X TAPE FROM CAASE1
READ COUNTY NO., HOUSES COUNT, POPULATION COUNT, LATITUDE, LONGITUDE, ZONE & X,Y COORDS.
END-OF-FILE ENCOUNTERED ?
YES
2000
HAS COUNTY MATCH BEEN MADE ?
YES
M p.9
NO
PRINT ERROR MESSAGE - DEALING WITH WRONG COUNTY
Y p.16
NO
IS THIS THE PRIMARY UTM ZONE ?
YES
E p.7
NO
CONVERT X AND Y COORDINATES TO DOUBLE PRECISION
INITIALIZE ERROR MESSAGE VARIABLE TO ZERO
p.7

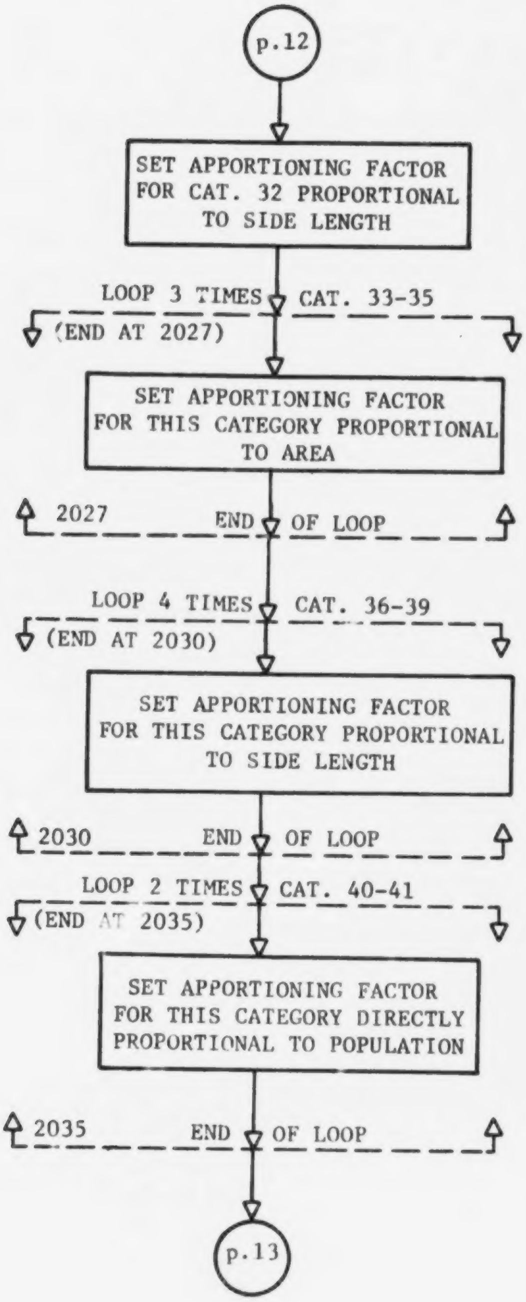

p.7
CALL SUBROUTINE GTGR FOR ZONE TO ZONE CONVERSION
WAS ERROR RETURNED FROM SUBROUTINE ?
NO
261
SET ZONE EQUAL TO PRIMARY ZONE
YES
PRINT ERROR MESSAGE
Y p.16
SET X AND Y COORDINATES TO SINGLE PRECISION
E
262
IS THIS RECORD TO BE PRINTED ?
YES
PRINT COUNTY CODE, NO. OF HOUSES, POPULATION, ZONE, AND X AND Y COORDINATES
JCNTY
HOUSES
PEOPLE
MZON
XCORD
YCORD
NO
265
IS THIS THE COUNTY OF INTEREST ?
NO
D p.6
YES
COUNTY MATCH MADE, SET COUNTY MATCH VARIABLE TO 1.
p.8

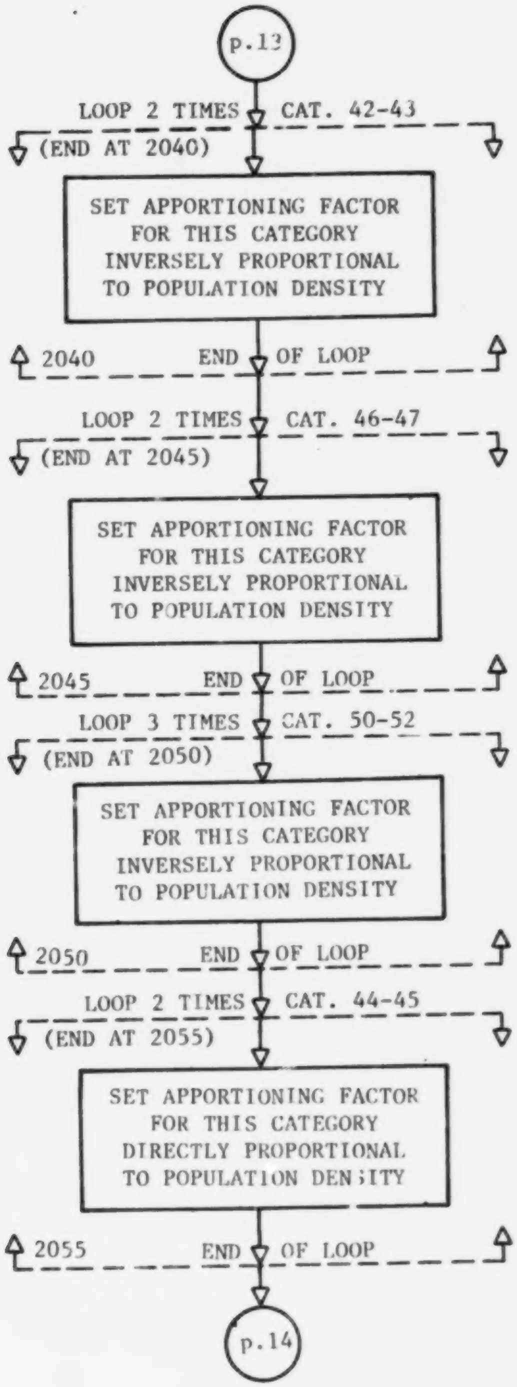

p.8
LOOP ON NO. OF AREA SOURCE GRIDS
(END AT 300)
DOES X COORDINATE FOR THIS POPULATION CENTER EXCEED X RANGE OF GRID
YES
NO
DOES Y COORDINATE FOR THIS POPULATION CENTER EXCEED Y RANGE OF GRID
YES
SUM HOUSING UNITS
SUM POPULATION UNITS
D p.6
300
END OF LOOP
PRINT MESSAGE THAT POPULATION CENTER IS NOT LOCATED IN ANY GRID SQUARES ASSIGNED TO THIS COUNTY
JCNTY, YCORD, YCORD, PEOPLE, HOUSES
D p.6

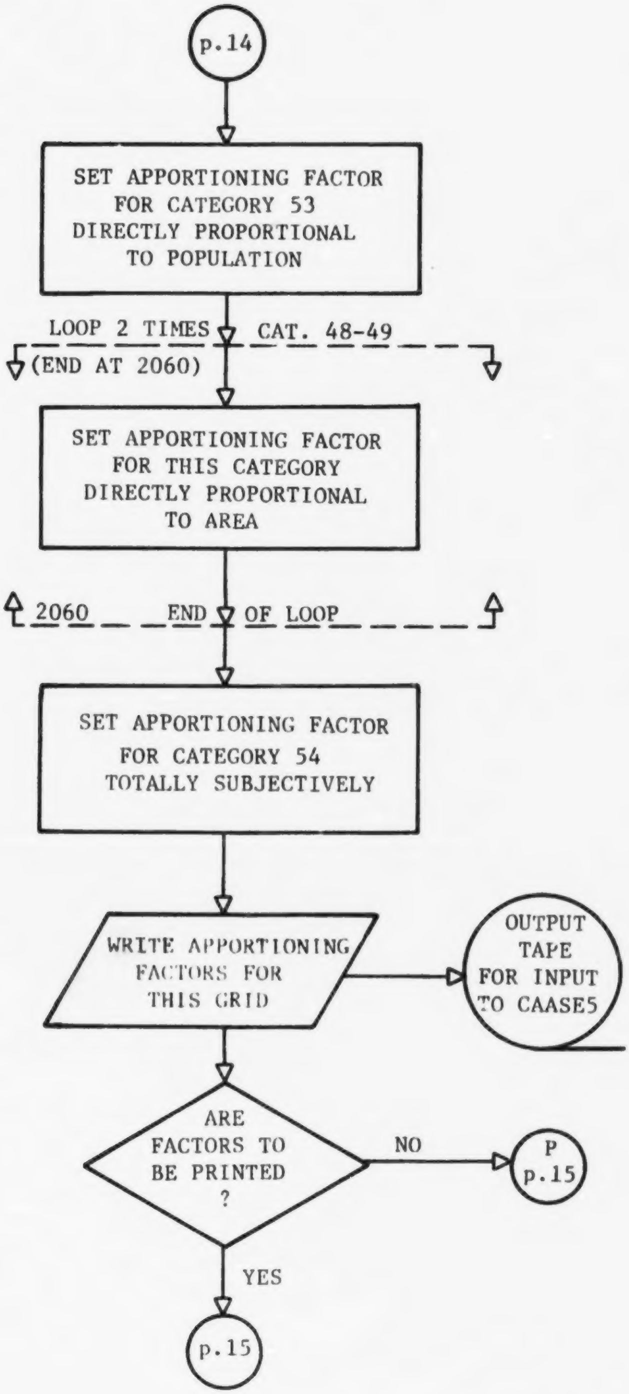

M
2005
LOOP ON NUMBER OF AREA SOURCE GRID SQUARES
(END AT 2100)
COMPUTE AREA BY SQUARING SIDE LENGTH OF THIS GRID
SET VARIABLE "SUM1" EQUAL HOUSING TOTAL FOR THIS GRID
SET VARIABLE "SUM2" EQUAL POPULATION TOTAL FOR THIS GRID
INITIALIZE INVERSELY PROPORTIONAL VARIABLE TO ZERO
IS POPULATION TOTAL EQUAL ZERO
NO
COMPUTE INVERSE "POPULATION DENSITY" VARIABLE
YES
p.10

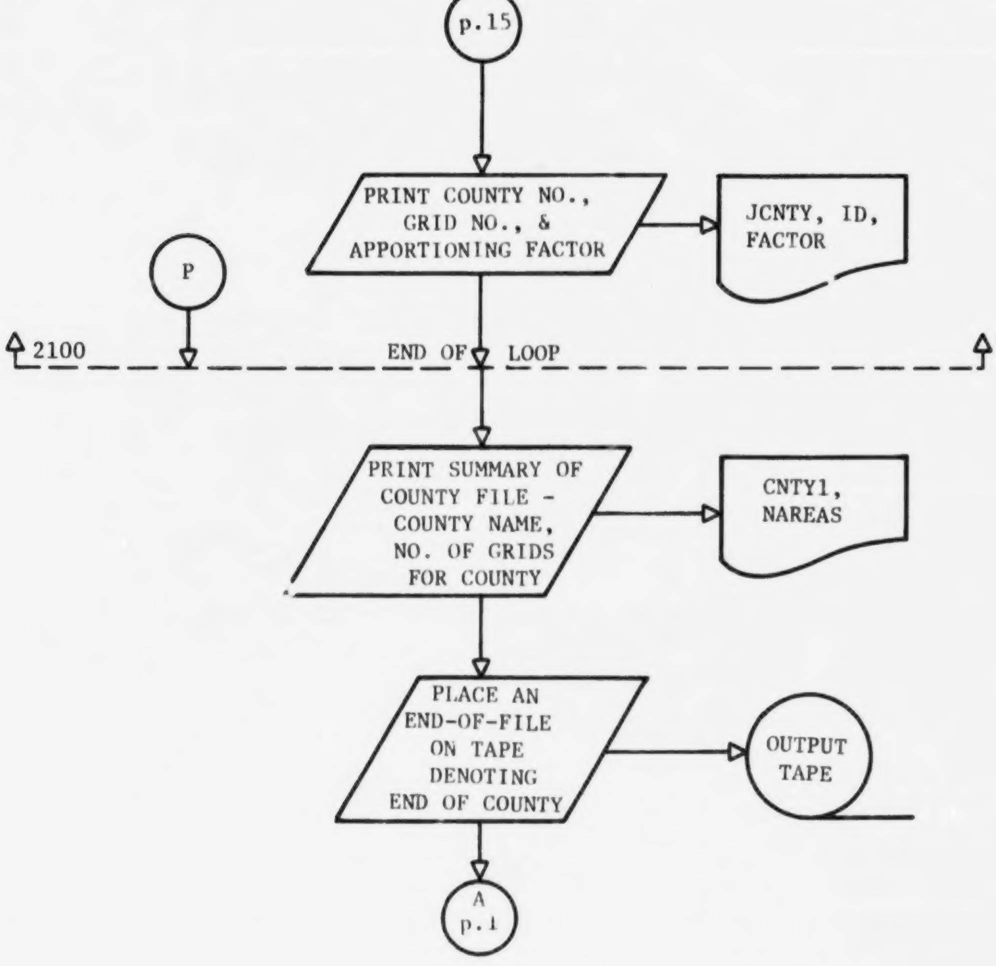

p.10
LOOP 6 TIMES - 1ST 6 CAT. RES. FUEL
(END AT 2010)
SET APPORTIONING FACTORS WHICH ARE FUNCTIONS OF HOUSING UNITS FOR THIS CATEGORY
2010 END OF LOOP
SET APPORTIONING FACTOR FOR CAT. 21 (RES. FUEL, ON-SITE INCINERATION)
SET APPORTIONING FACTOR FOR CAT. 24 (RES. FUEL, OPEN BURNING)
LOOP 14 TIMES CAT. 7-20
(END AT 2015)
SET APPORTIONING FACTORS WHICH ARE DIRECTLY PROPORTIONAL TO POPULATION FOR THIS CAT. OF COMM. & INST. AND IND. FUEL
2015 END OF LOOP
p.11

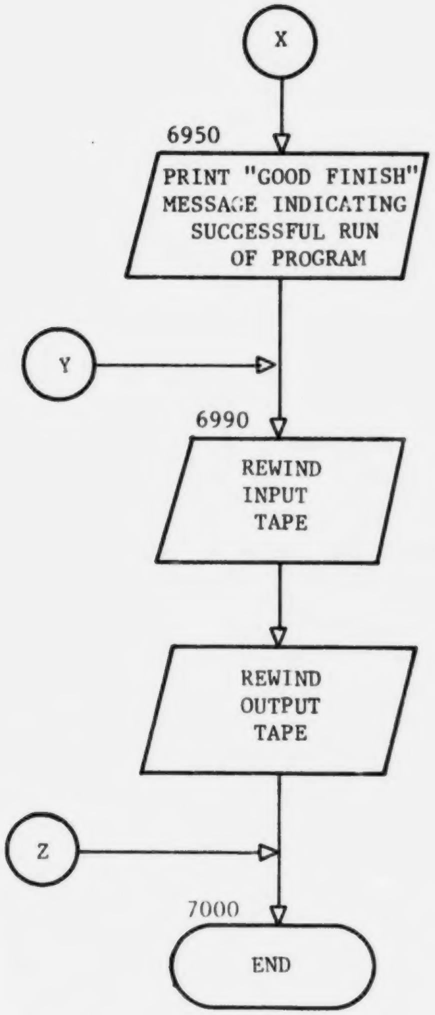

p.11
LOOP 2 TIMES
CAT. 22-23
(END AT 2020)
SET APPORTIONING FACTOR FOR THIS CATEGORY
2020
END OF LOOP
LOOP 4 TIMES
CAT. 25-28
(END AT 2025)
SET APPORTIONING FACTORS FOR THIS CATEGORY
2025
END OF LOOP
SET APPORTIONING FACTOR FOR CATEGORY 29 INVERSELY PROPORTIONAL TO POPULATION DENSITY
SET APPORTIONING FACTOR FOR CAT. 31 INVERSELY PROPORTIONAL TO POPULATION DENSITY
SET APPORTIONING FACTOR FOR CAT. 30 DIRECTLY PROPORTIONAL TO POPULATION DENSITY
p.12


p.12
SET APPORTIONING FACTOR FOR CAT. 32 PROPORTIONAL TO SIDE LENGTH
LOOP 3 TIMES
CAT. 33-35
(END AT 2027)
SET APPORTIONING FACTOR FOR THIS CATEGORY PROPORTIONAL TO AREA
2027
END OF LOOP
LOOP 4 TIMES
CAT. 36-39
(END AT 2030)
SET APPORTIONING FACTOR FOR THIS CATEGORY PROPORTIONAL TO SIDE LENGTH
2030
END OF LOOP
LOOP 2 TIMES
CAT. 40-41
(END AT 2035)
SET APPORTIONING FACTOR FOR THIS CATEGORY DIRECTLY PROPORTIONAL TO POPULATION
2035
END OF LOOP
p.13


p.13
LOOP 2 TIMES
CAT. 42-43
(END AT 2040)
SET APPORTIONING FACTOR FOR THIS CATEGORY INVERSELY PROPORTIONAL TO POPULATION DENSITY
2040
END OF LOOP
LOOP 2 TIMES
CAT. 46-47
(END AT 2045)
SET APPORTIONING FACTOR FOR THIS CATEGORY INVERSELY PROPORTIONAL TO POPULATION DENSITY
2045
END OF LOOP
LOOP 3 TIMES
CAT. 50-52
(END AT 2050)
SET APPORTIONING FACTOR FOR THIS CATEGORY INVERSELY PROPORTIONAL TO POPULATION DENSITY
2050
END OF LOOP
LOOP 2 TIMES
CAT. 44-45
(END AT 2055)
SET APPORTIONING FACTOR FOR THIS CATEGORY DIRECTLY PROPORTIONAL TO POPULATION DENSITY
2055
END OF LOOP
p.14


p.14
SET APPORTIONING FACTOR FOR CATEGORY 53 DIRECTLY PROPORTIONAL TO POPULATION
LOOP 2 TIMES
CAT. 48-49
(END AT 2060)
SET APPORTIONING FACTOR FOR THIS CATEGORY DIRECTLY PROPORTIONAL TO AREA
2060
END OF LOOP
SET APPORTIONING FACTOR FOR CATEGORY 54 TOTALLY SUBJECTIVELY
WRITE APPORTIONING FACTORS FOR THIS GRID
OUTPUT TAPE FOR INPUT TO CAASE5
ARE FACTORS TO BE PRINTED ?
NO
P p.15
YES
p.15

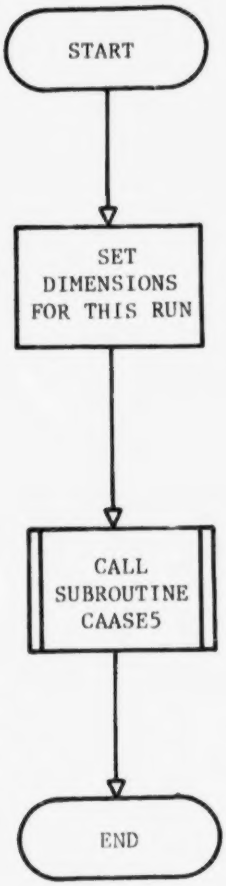

p.15
PRINT COUNTY NO., GRID NO., & APPORTIONING FACTOR
JCNTY, ID, FACTOR
P
2100
END OF LOOP
PRINT SUMMARY OF COUNTY FILE - COUNTY NAME, NO. OF GRIDS FOR COUNTY
CNTY1, NAREAS
PLACE AN END-OF-FILE ON TAPE DENOTING END OF COUNTY
OUTPUT TAPE
A
p.1


X
6950
PRINT "GOOD FINISH" MESSAGE INDICATING SUCCESSFUL RUN OF PROGRAM
Y
6990
REWIND INPUT TAPE
REWIND OUTPUT TAPE
Z
7000
END

APPENDIX E

LOGICAL FLOW CHARTS — CAASE5 (and Subroutines)

CAASE 5
(DRIVER)


START
SET DIMENSIONS FOR THIS RUN
CALL SUBROUTINE CAASE5
END

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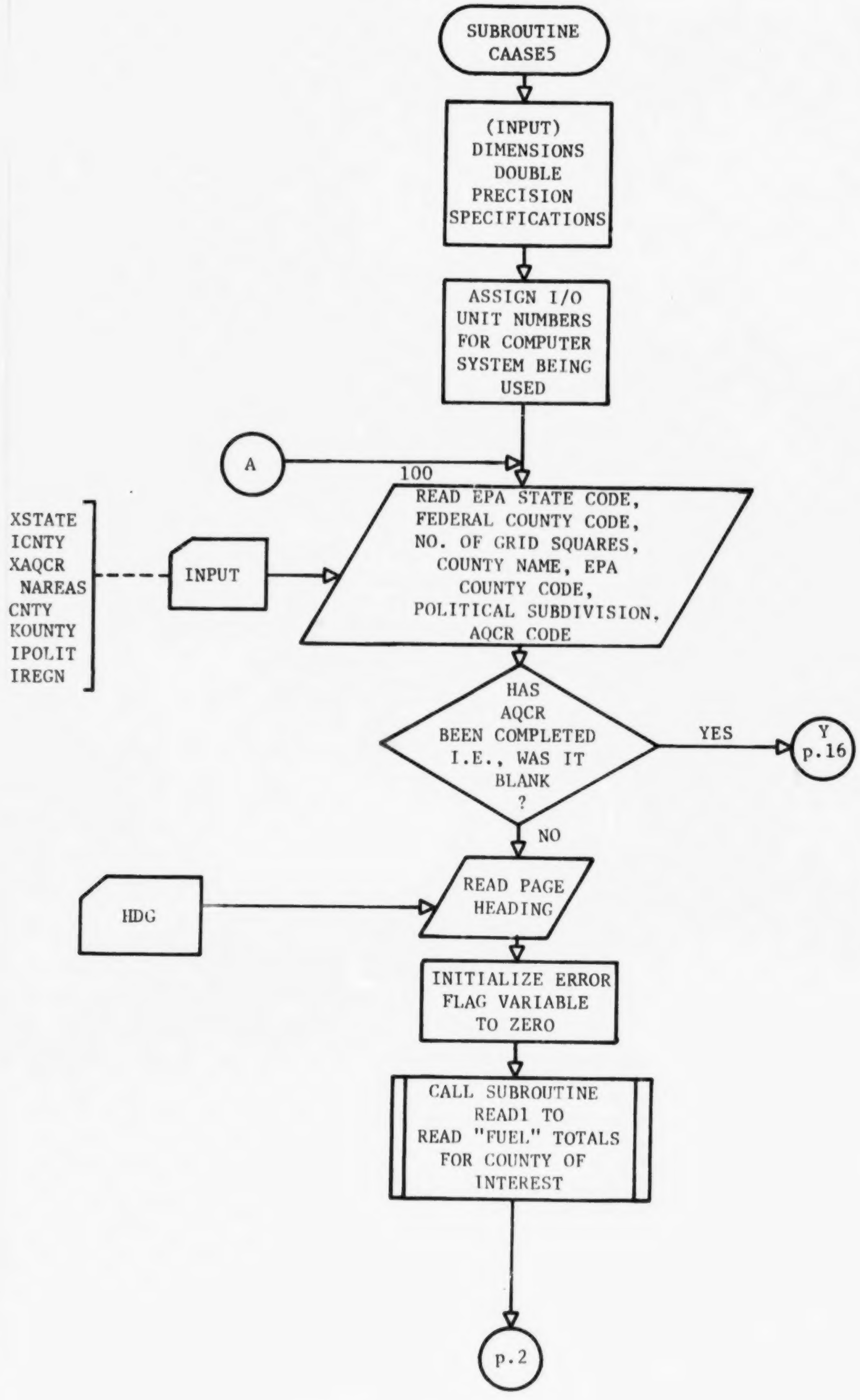
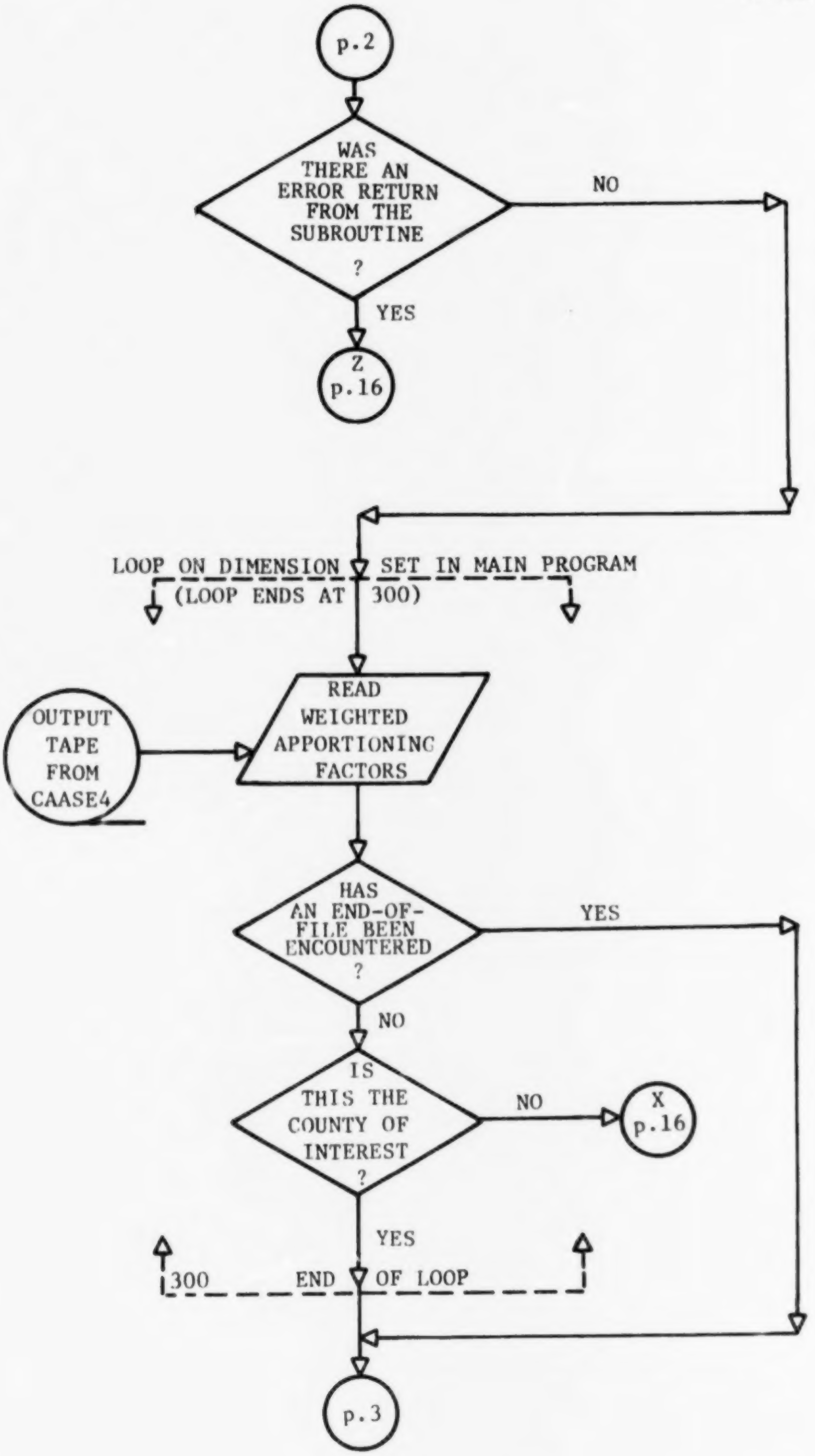
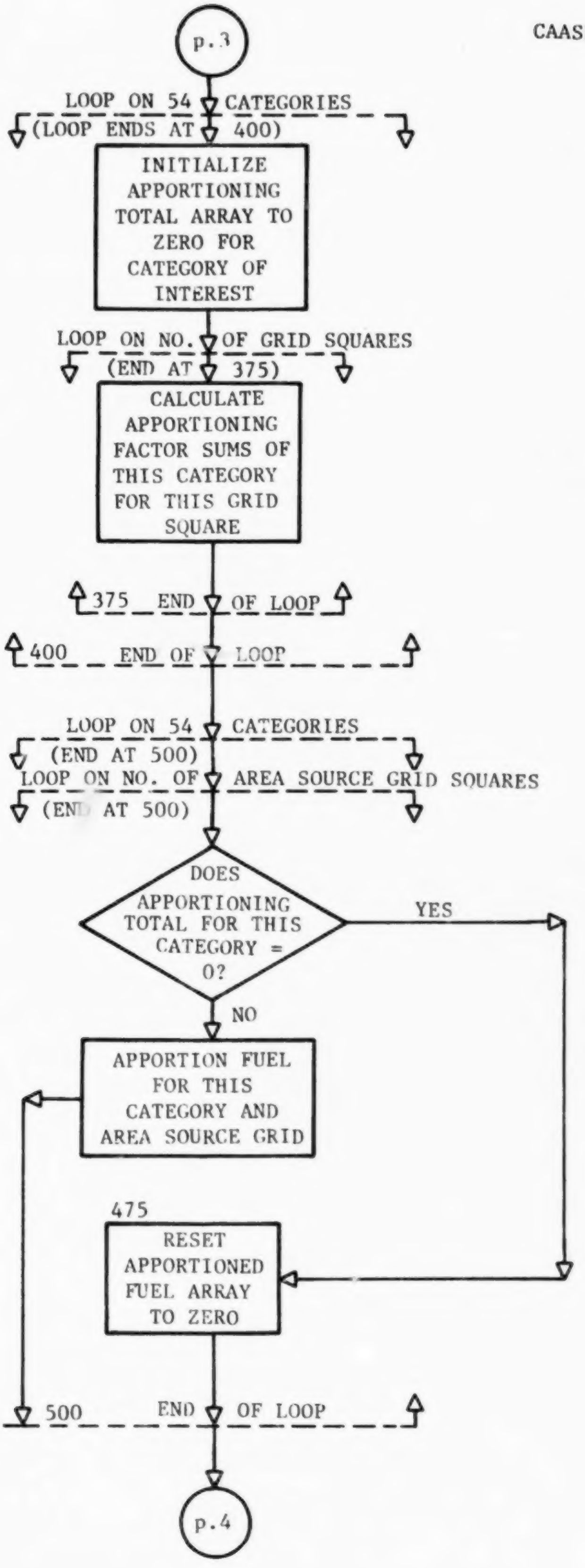
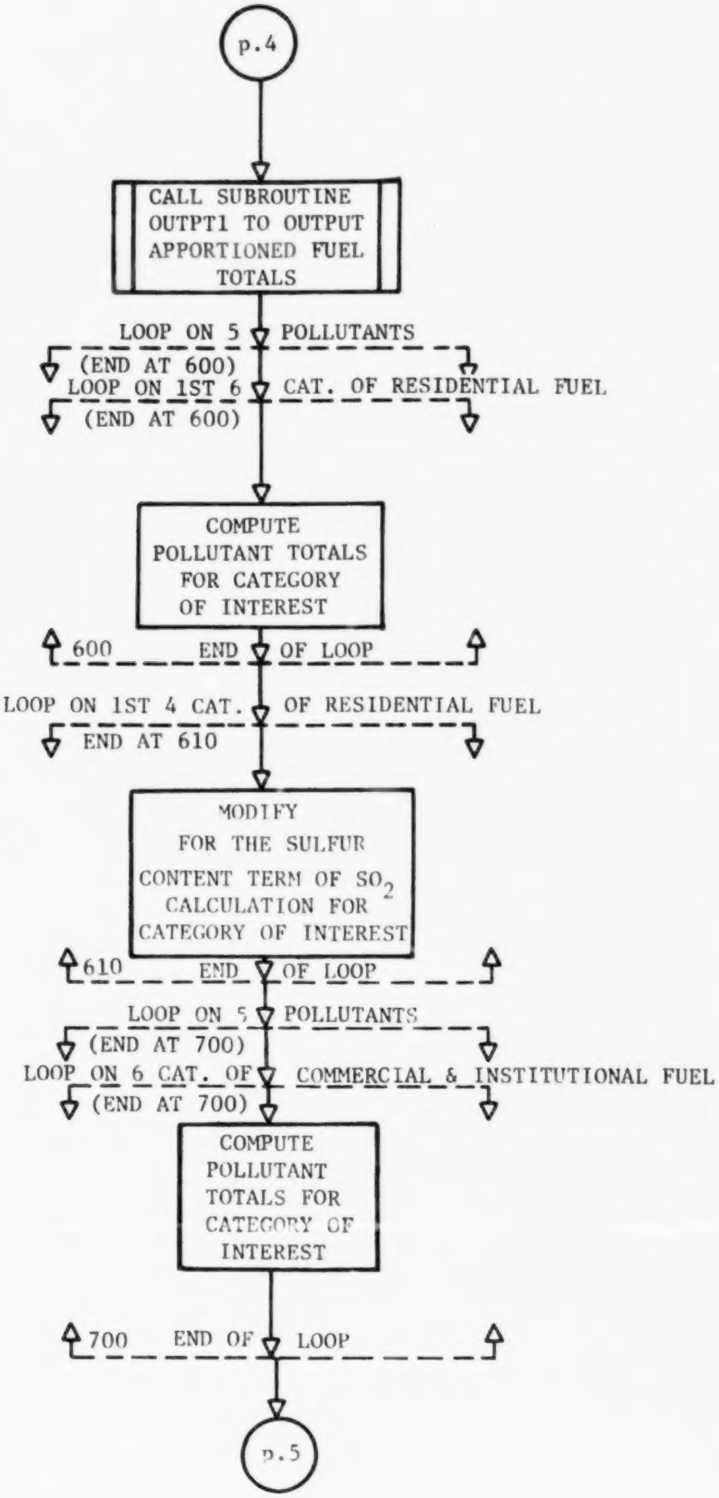
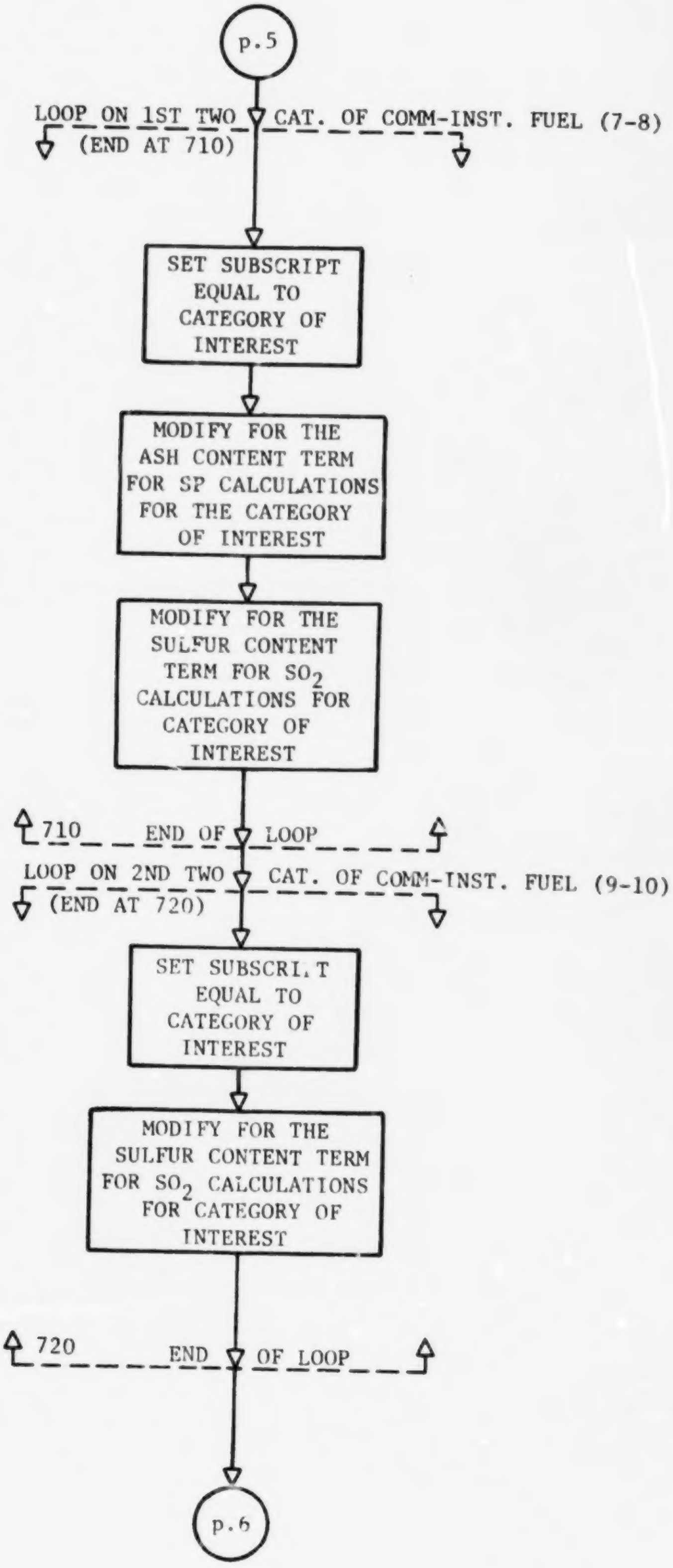
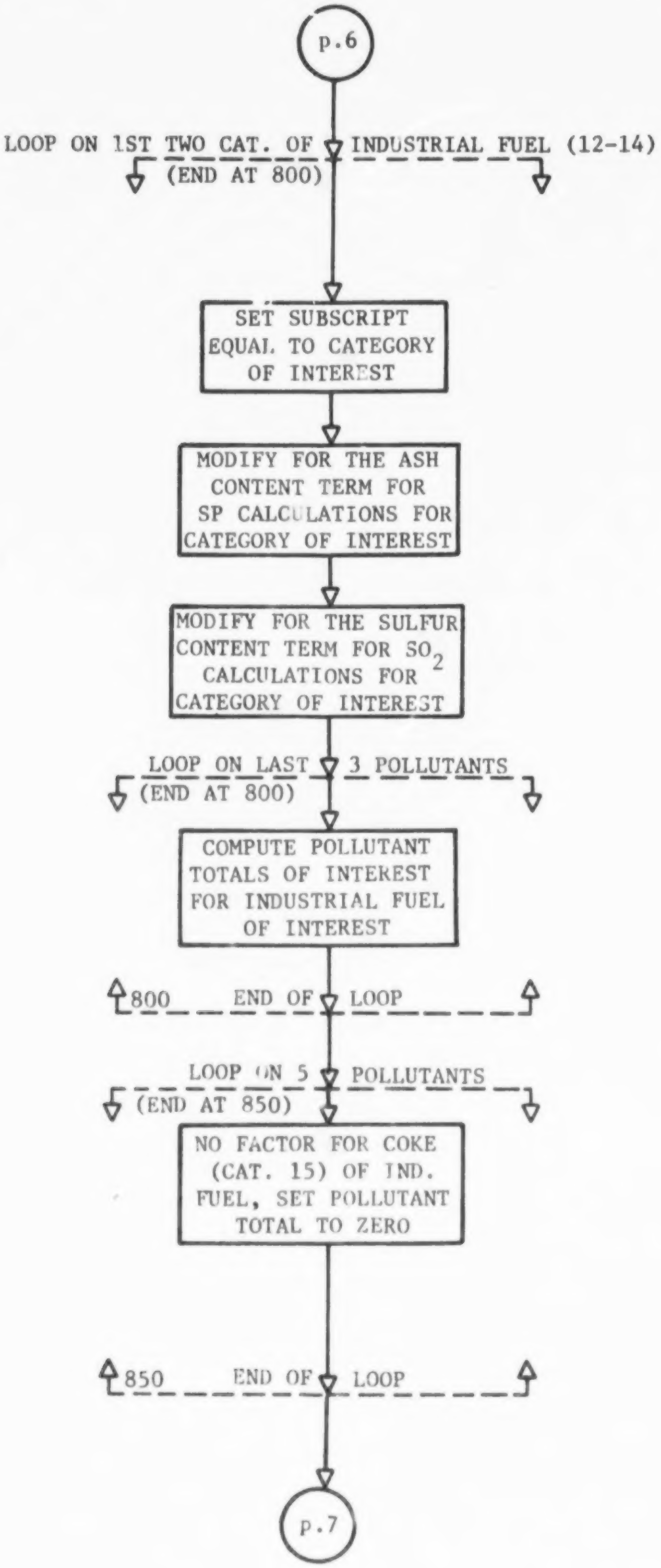

SUBROUTINE CAASE5
(INPUT) DIMENSIONS DOUBLE PRECISION SPECIFICATIONS
ASSIGN I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED
A
100
READ EPA STATE CODE, FEDERAL COUNTY CODE, NO. OF GRID SQUARES, COUNTY NAME, EPA COUNTY CODE, POLITICAL SUBDIVISION, AQCR CODE
XSTATE
ICNTY
XAQCR
NAREAS
CNTY
KOUNTY
IPOLIT
IREGN
INPUT
HAS AQCR BEEN COMPLETED I.E., WAS IT BLANK ?
YES
Y p.16
NO
HDG
READ PAGE HEADING
INITIALIZE ERROR FLAG VARIABLE TO ZERO
CALL SUBROUTINE READ1 TO READ "FUEL" TOTALS FOR COUNTY OF INTEREST
p.2

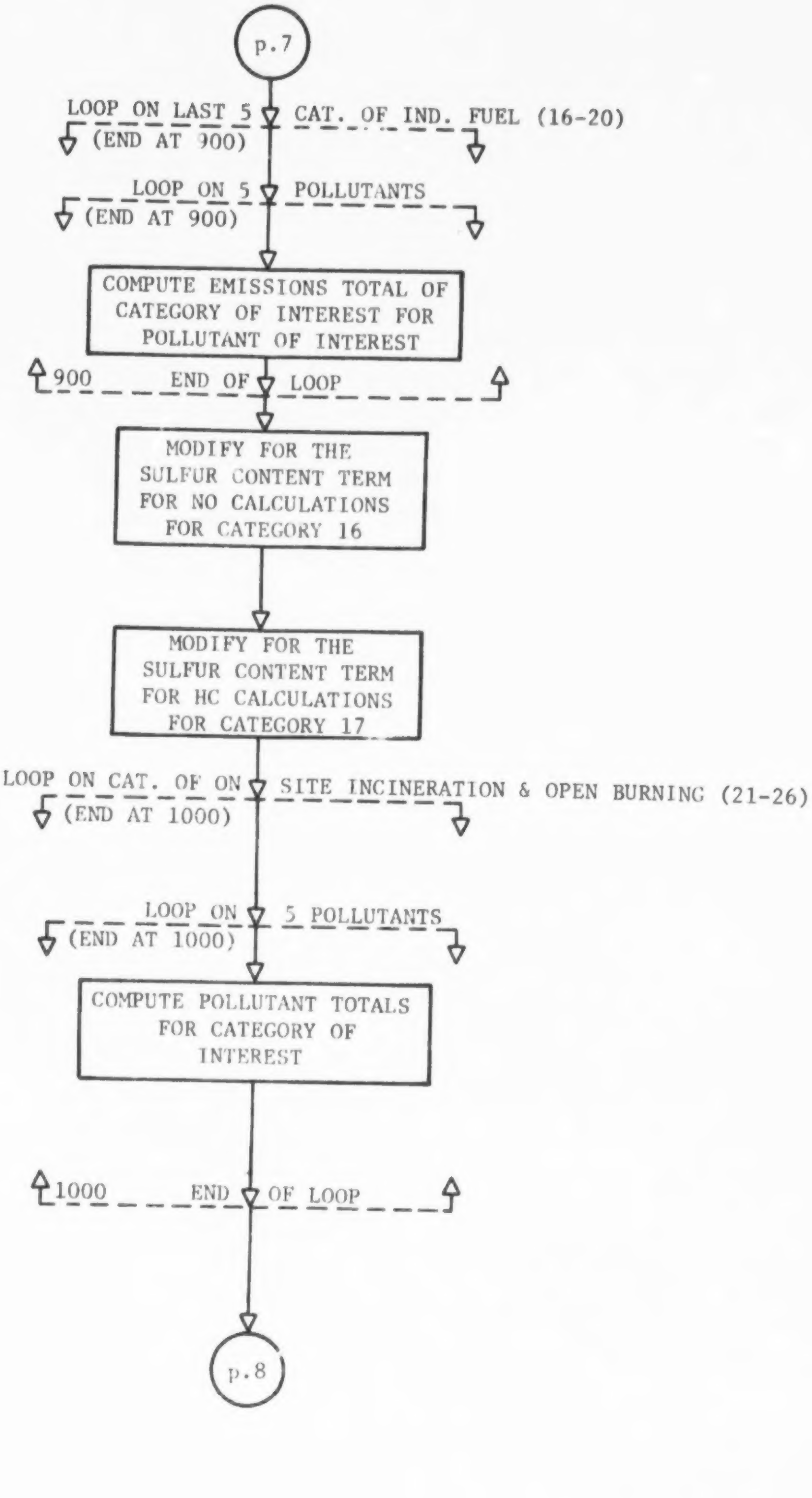

p.2
WAS THERE AN ERROR RETURN FROM THE SUBROUTINE ?
NO
YES
Z p.16
LOOP ON DIMENSION SET IN MAIN PROGRAM
(LOOP ENDS AT 300)
OUTPUT TAPE FROM CAASE4
READ WEIGHTED APPORTIONING FACTORS
HAS AN END-OF-FILE BEEN ENCOUNTERED ?
YES
NO
IS THIS THE COUNTY OF INTEREST ?
NO
X p.16
YES
300 END OF LOOP
p.3

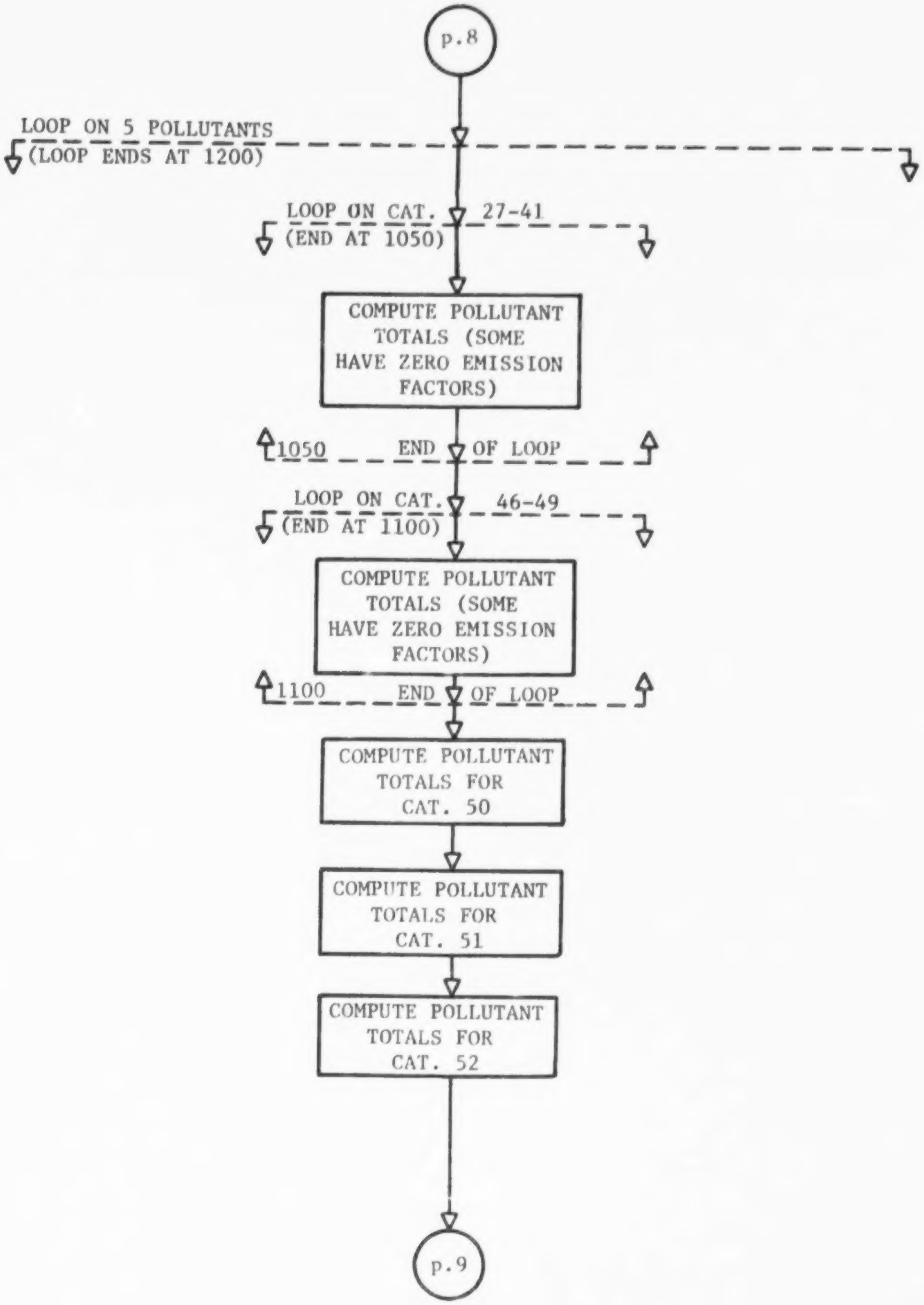

p.3
LOOP ON 54 CATEGORIES
(LOOP ENDS AT 400)
INITIALIZE APPORTIONING TOTAL ARRAY TO ZERO FOR CATEGORY OF INTEREST
LOOP ON NO. OF GRID SQUARES
(END AT 375)
CALCULATE APPORTIONING FACTOR SUMS OF THIS CATEGORY FOR THIS GRID SQUARE
375 END OF LOOP
400 END OF LOOP
LOOP ON 54 CATEGORIES
(END AT 500)
LOOP ON NO. OF AREA SOURCE GRID SQUARES
(END AT 500)
DOES APPORTIONING TOTAL FOR THIS CATEGORY = 0?
YES
NO
APPORTION FUEL FOR THIS CATEGORY AND AREA SOURCE GRID
475
RESET APPORTIONED FUEL ARRAY TO ZERO
500 END OF LOOP
p.4

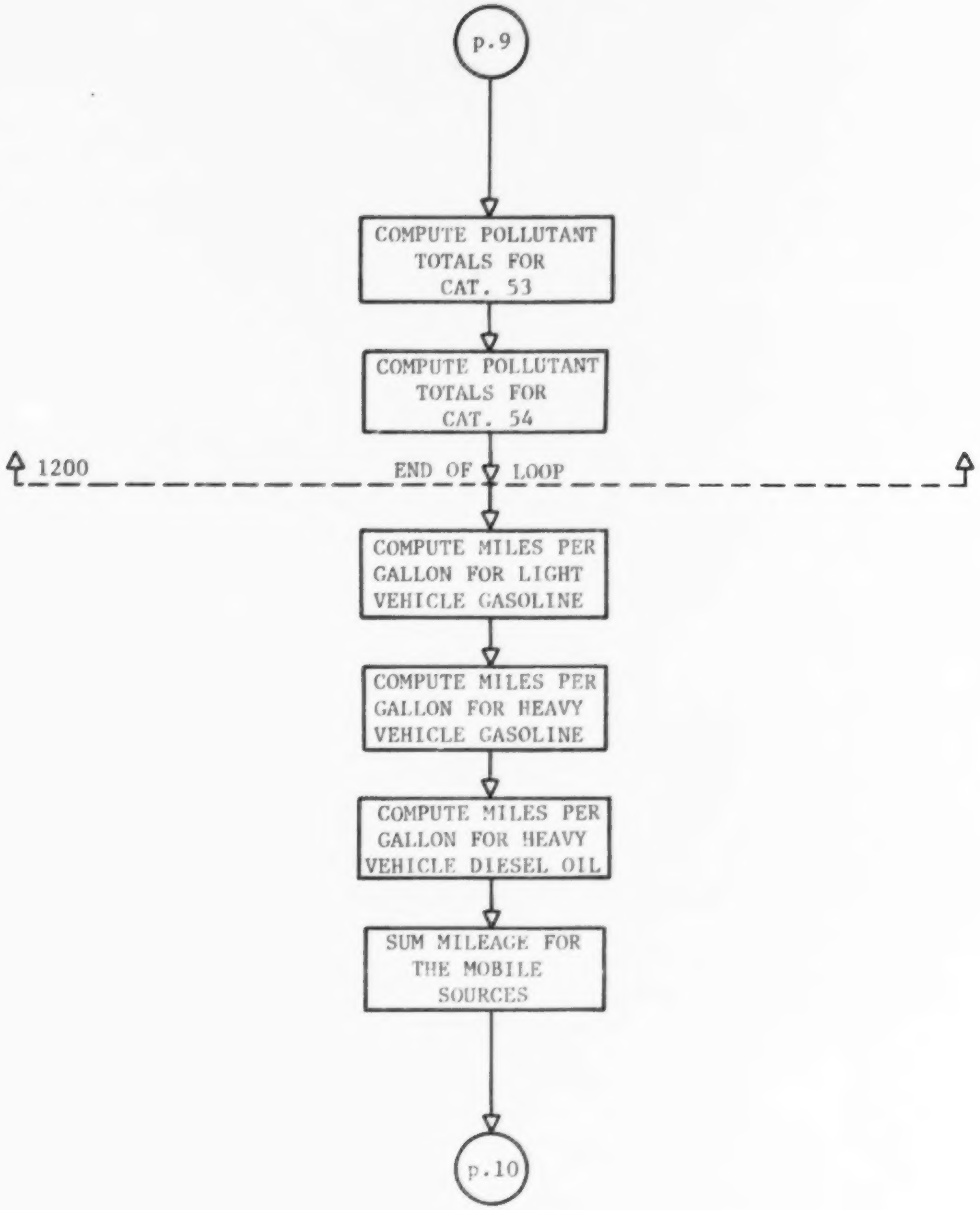

p.4
CALL SUBROUTINE OUTPT1 TO OUTPUT APPORTIONED FUEL TOTALS
LOOP ON 5 POLLUTANTS
(END AT 600)
LOOP ON 1ST 6 CAT. OF RESIDENTIAL FUEL
(END AT 600)
COMPUTE POLLUTANT TOTALS FOR CATEGORY OF INTEREST
600 END OF LOOP
LOOP ON 1ST 4 CAT. OF RESIDENTIAL FUEL
END AT 610
MODIFY FOR THE SULFUR CONTENT TERM OF SO2 CALCULATION FOR CATEGORY OF INTEREST
610 END OF LOOP
LOOP ON 5 POLLUTANTS
(END AT 700)
LOOP ON 6 CAT. OF COMMERCIAL & INSTITUTIONAL FUEL
(END AT 700)
COMPUTE POLLUTANT TOTALS FOR CATEGORY OF INTEREST
700 END OF LOOP
p.5

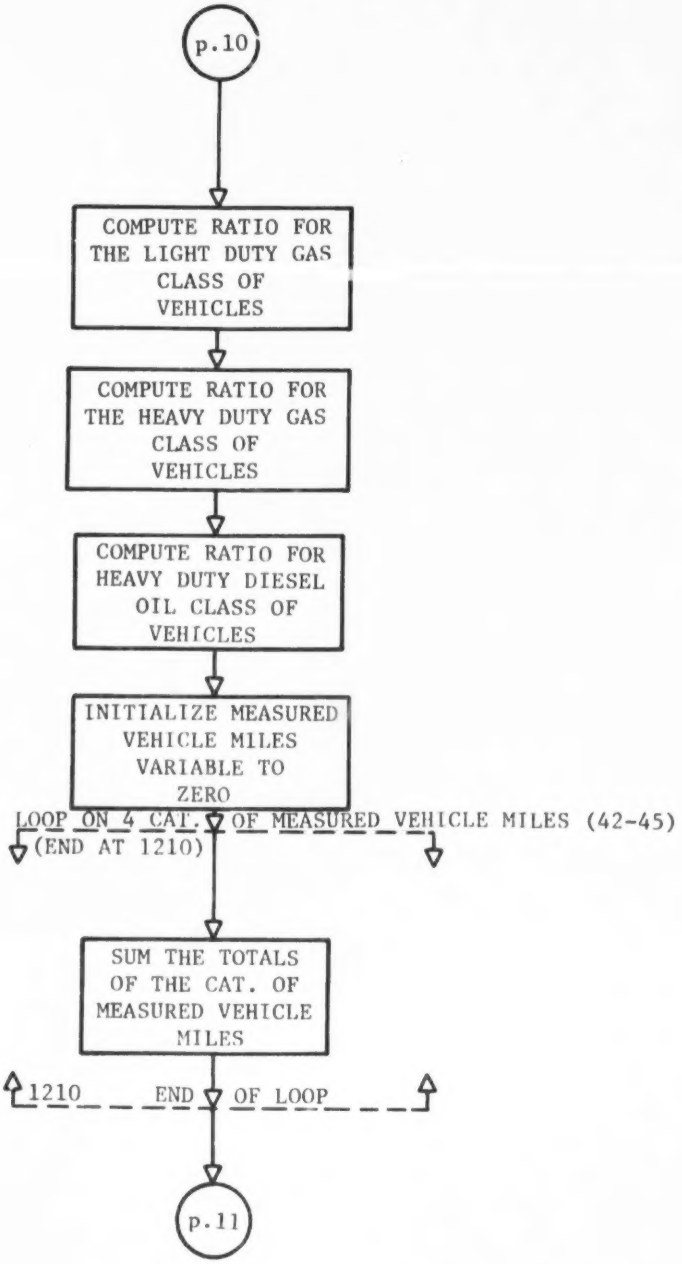

p.5
LOOP ON 1ST TWO CAT. OF COMM-INST. FUEL (7-8)
(END AT 710)
SET SUBSCRIPT EQUAL TO CATEGORY OF INTEREST
MODIFY FOR THE ASH CONTENT TERM FOR SP CALCULATIONS FOR THE CATEGORY OF INTEREST
MODIFY FOR THE SULFUR CONTENT TERM FOR SO_2 CALCULATIONS FOR CATEGORY OF INTEREST
710 END OF LOOP
LOOP ON 2ND TWO CAT. OF COMM-INST. FUEL (9-10)
(END AT 720)
SET SUBSCRIPT EQUAL TO CATEGORY OF INTEREST
MODIFY FOR THE SULFUR CONTENT TERM FOR SO_2 CALCULATIONS FOR CATEGORY OF INTEREST
720 END OF LOOP
p.6

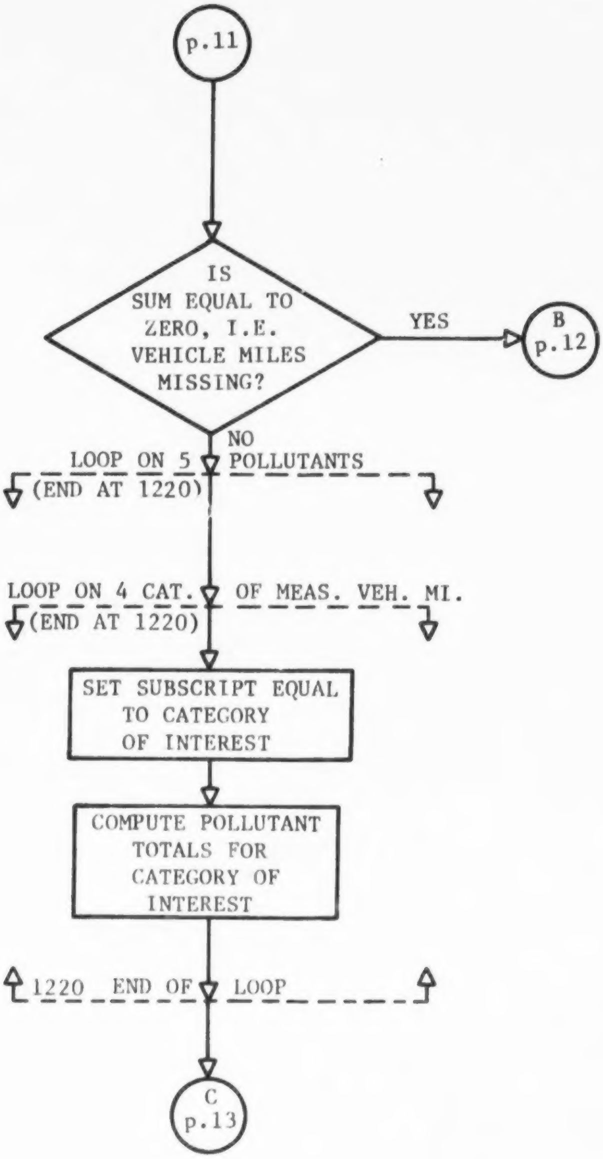

p.6
LOOP ON 1ST TWO CAT. OF INDUSTRIAL FUEL (12-14)
(END AT 800)
SET SUBSCRIPT EQUAL TO CATEGORY OF INTEREST
MODIFY FOR THE ASH CONTENT TERM FOR SP CALCULATIONS FOR CATEGORY OF INTEREST
MODIFY FOR THE SULFUR CONTENT TERM FOR SO2 CALCULATIONS FOR CATEGORY OF INTEREST
LOOP ON LAST 3 POLLUTANTS
(END AT 800)
COMPUTE POLLUTANT TOTALS OF INTEREST FOR INDUSTRIAL FUEL OF INTEREST
800 END OF LOOP
LOOP ON 5 POLLUTANTS
(END AT 850)
NO FACTOR FOR COKE (CAT. 15) OF IND. FUEL, SET POLLUTANT TOTAL TO ZERO
850 END OF LOOP
p.7

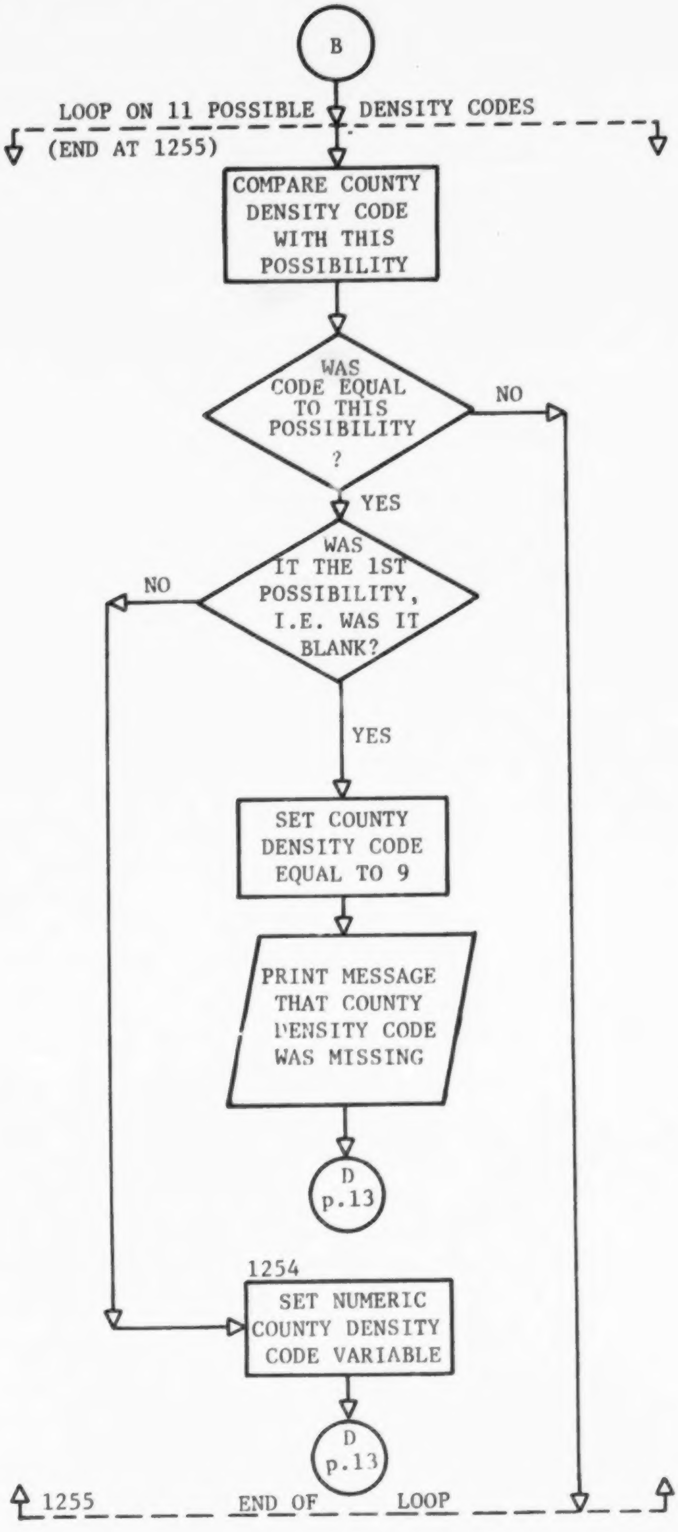

p.7
LOOP ON LAST 5 CAT. OF IND. FUEL (16-20)
(END AT 900)
LOOP ON 5 POLLUTANTS
(END AT 900)
COMPUTE EMISSIONS TOTAL OF CATEGORY OF INTEREST FOR POLLUTANT OF INTEREST
900 END OF LOOP
MODIFY FOR THE SULFUR CONTENT TERM FOR NO CALCULATIONS FOR CATEGORY 16
MODIFY FOR THE SULFUR CONTENT TERM FOR HC CALCULATIONS FOR CATEGORY 17
LOOP ON CAT. OF ON SITE INCINERATION & OPEN BURNING (21-26)
(END AT 1000)
LOOP ON 5 POLLUTANTS
(END AT 1000)
COMPUTE POLLUTANT TOTALS FOR CATEGORY OF INTEREST
1000 END OF LOOP
p.8

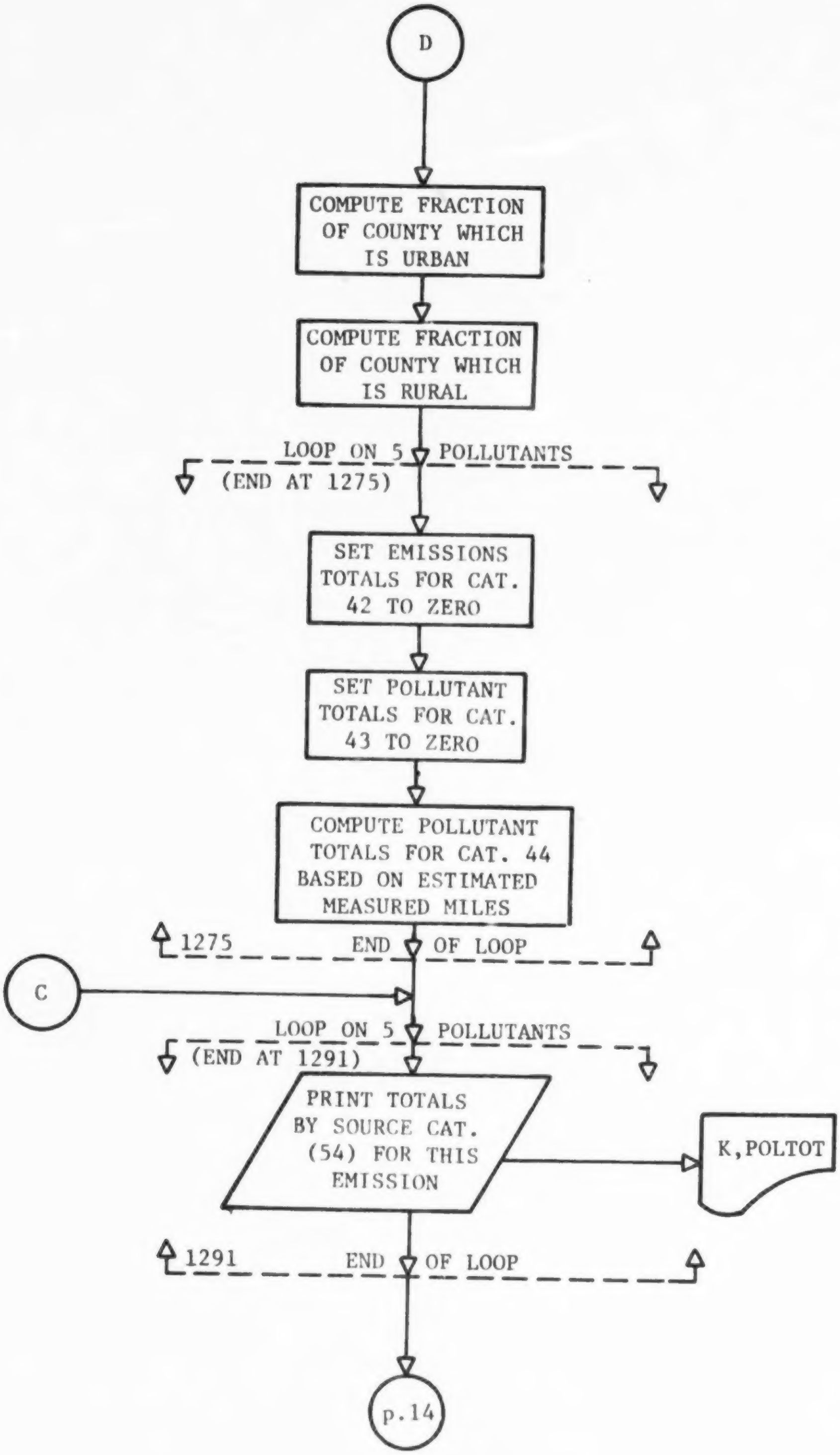

p.8
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1200)
LOOP ON CAT. 27-41
(END AT 1050)
COMPUTE POLLUTANT TOTALS (SOME HAVE ZERO EMISSION FACTORS)
1050 END OF LOOP
LOOP ON CAT. 46-49
(END AT 1100)
COMPUTE POLLUTANT TOTALS (SOME HAVE ZERO EMISSION FACTORS)
1100 END OF LOOP
COMPUTE POLLUTANT TOTALS FOR CAT. 50
COMPUTE POLLUTANT TOTALS FOR CAT. 51
COMPUTE POLLUTANT TOTALS FOR CAT. 52
p.9

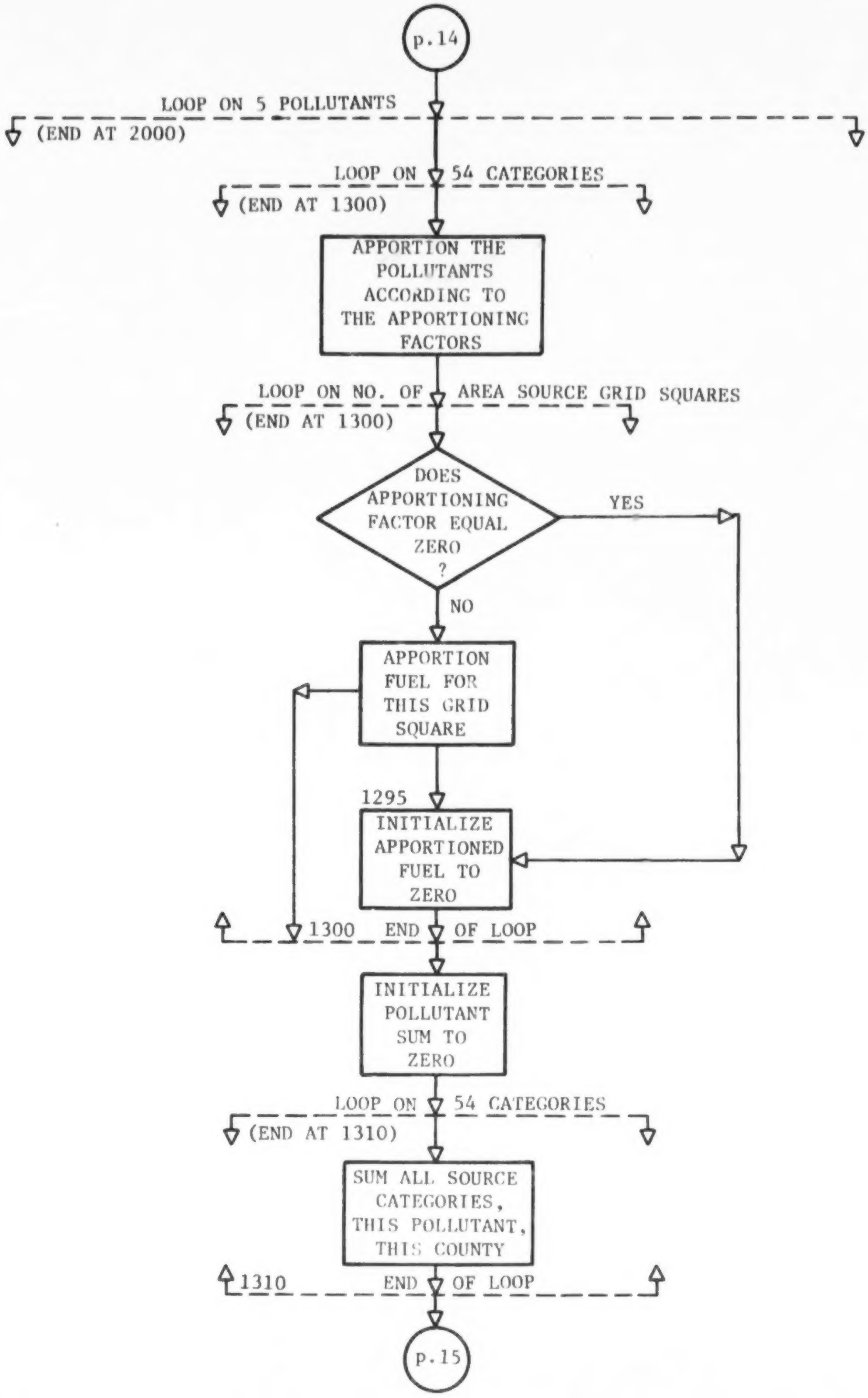

p.9
COMPUTE POLLUTANT TOTALS FOR CAT. 53
COMPUTE POLLUTANT TOTALS FOR CAT. 54
1200
END OF LOOP
COMPUTE MILES PER GALLON FOR LIGHT VEHICLE GASOLINE
COMPUTE MILES PER GALLON FOR HEAVY VEHICLE GASOLINE
COMPUTE MILES PER GALLON FOR HEAVY VEHICLE DIESEL OIL
SUM MILEAGE FOR THE MOBILE SOURCES
p.10

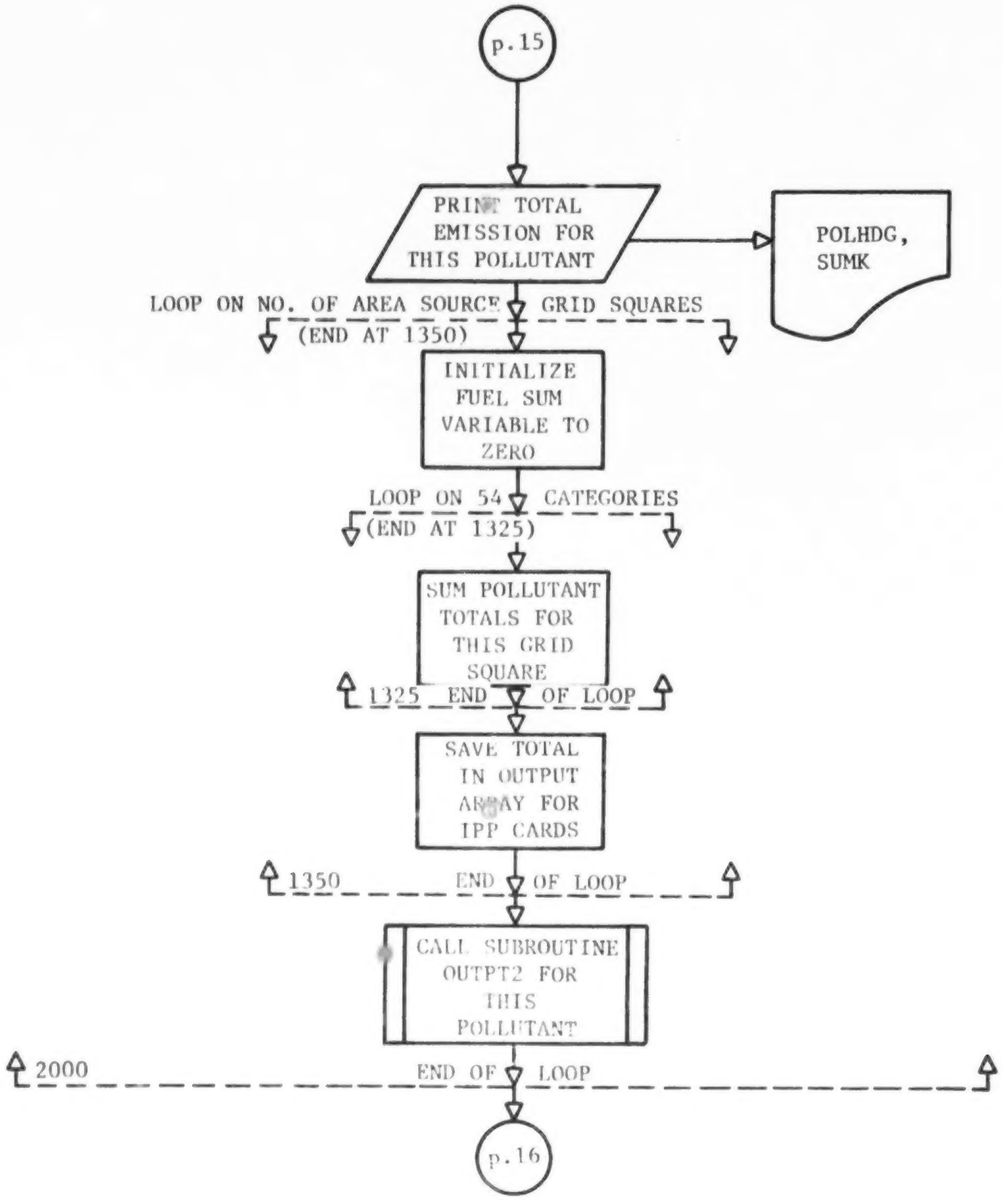

p.10
COMPUTE RATIO FOR THE LIGHT DUTY GAS CLASS OF VEHICLES
COMPUTE RATIO FOR THE HEAVY DUTY GAS CLASS OF VEHICLES
COMPUTE RATIO FOR HEAVY DUTY DIESEL OIL CLASS OF VEHICLES
INITIALIZE MEASURED VEHICLE MILES VARIABLE TO ZERO
LOOP ON 4 CAT. OF MEASURED VEHICLE MILES (42-45)
(END AT 1210)
SUM THE TOTALS OF THE CAT. OF MEASURED VEHICLE MILES
1210 END OF LOOP
p.11

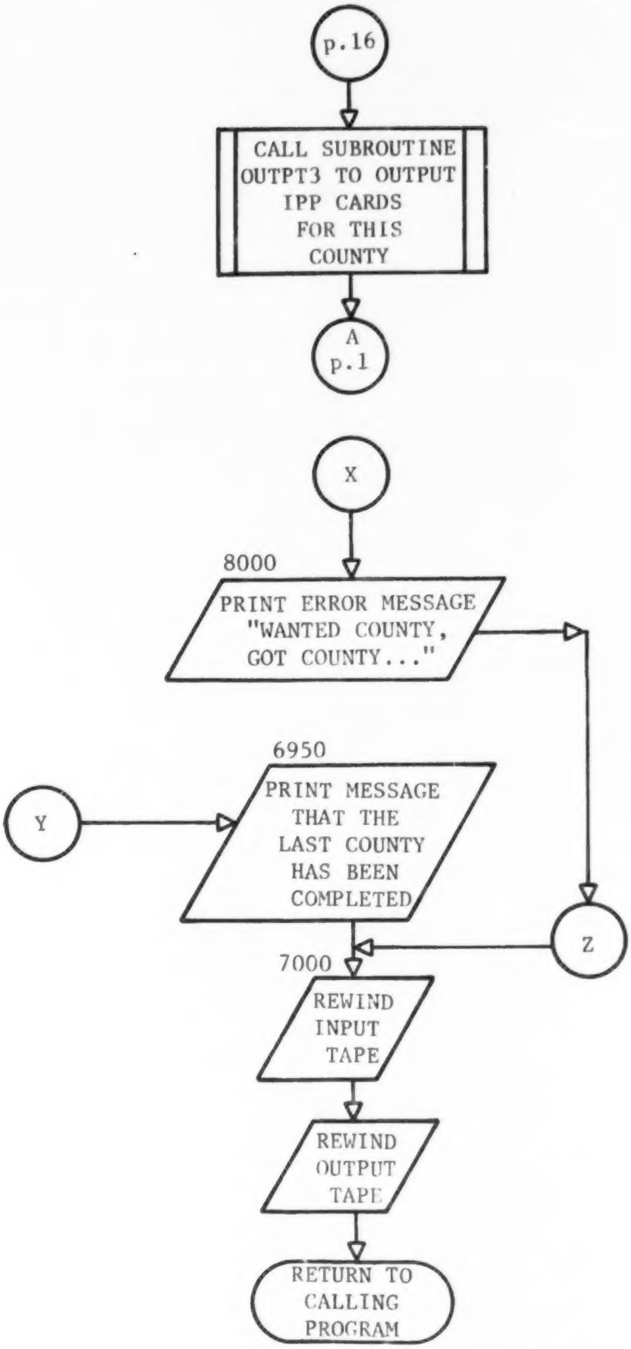

p.11
IS SUM EQUAL TO ZERO, I.E. VEHICLE MILES MISSING?
YES
B p.12
NO
LOOP ON 5 POLLUTANTS
(END AT 1220)
LOOP ON 4 CAT. OF MEAS. VEH. MI.
(END AT 1220)
SET SUBSCRIPT EQUAL TO CATEGORY OF INTEREST
COMPUTE POLLUTANT TOTALS FOR CATEGORY OF INTEREST
1220 END OF LOOP
C p.13

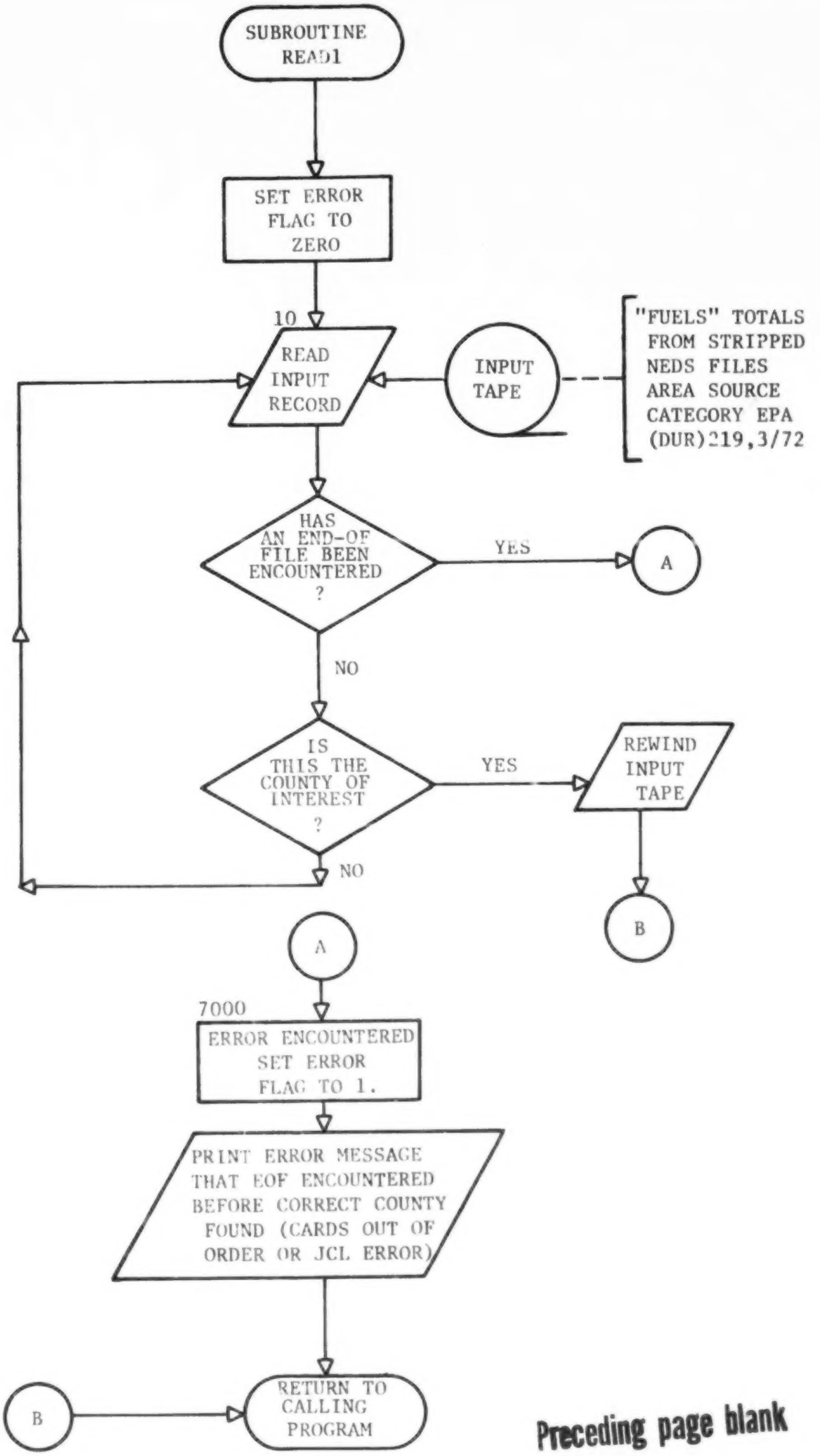

B
LOOP ON 11 POSSIBLE DENSITY CODES
(END AT 1255)
COMPARE COUNTY DENSITY CODE WITH THIS POSSIBILITY
WAS CODE EQUAL TO THIS POSSIBILITY ?
NO
YES
WAS IT THE 1ST POSSIBILITY, I.E. WAS IT BLANK?
NO
YES
SET COUNTY DENSITY CODE EQUAL TO 9
PRINT MESSAGE THAT COUNTY DENSITY CODE WAS MISSING
D p.13
1254
SET NUMERIC COUNTY DENSITY CODE VARIABLE
D p.13
1255
END OF LOOP


D
COMPUTE FRACTION OF COUNTY WHICH IS URBAN
COMPUTE FRACTION OF COUNTY WHICH IS RURAL
LOOP ON 5 POLLUTANTS
(END AT 1275)
SET EMISSIONS TOTALS FOR CAT. 42 TO ZERO
SET POLLUTANT TOTALS FOR CAT. 43 TO ZERO
COMPUTE POLLUTANT TOTALS FOR CAT. 44 BASED ON ESTIMATED MEASURED MILES
1275
END OF LOOP
C
LOOP ON 5 POLLUTANTS
(END AT 1291)
PRINT TOTALS BY SOURCE CAT. (54) FOR THIS EMISSION
K,POLTOT
1291
END OF LOOP
p.14


p.14
LOOP ON 5 POLLUTANTS
(END AT 2000)
LOOP ON 54 CATEGORIES
(END AT 1300)
APPORTION THE POLLUTANTS ACCORDING TO THE APPORTIONING FACTORS
LOOP ON NO. OF AREA SOURCE GRID SQUARES
(END AT 1300)
DOES APPORTIONING FACTOR EQUAL ZERO ?
YES
NO
APPORTION FUEL FOR THIS GRID SQUARE
1295
INITIALIZE APPORTIONED FUEL TO ZERO
1300 END OF LOOP
INITIALIZE POLLUTANT SUM TO ZERO
LOOP ON 54 CATEGORIES
(END AT 1310)
SUM ALL SOURCE CATEGORIES, THIS POLLUTANT, THIS COUNTY
1310 END OF LOOP
p.15


p.15
PRINT TOTAL EMISSION FOR THIS POLLUTANT
POLHDG, SUMK
LOOP ON NO. OF AREA SOURCE GRID SQUARES
(END AT 1350)
INITIALIZE FUEL SUM VARIABLE TO ZERO
LOOP ON 54 CATEGORIES
(END AT 1325)
SUM POLLUTANT TOTALS FOR THIS GRID SQUARE
1325 END OF LOOP
SAVE TOTAL IN OUTPUT ARRAY FOR IPP CARDS
1350 END OF LOOP
CALL SUBROUTINE OUTPT2 FOR THIS POLLUTANT
2000 END OF LOOP
p.16


p.16
CALL SUBROUTINE OUTPT3 TO OUTPUT IPP CARDS FOR THIS COUNTY
A p.1
X
8000
PRINT ERROR MESSAGE "WANTED COUNTY, GOT COUNTY..."
6950
Y
PRINT MESSAGE THAT THE LAST COUNTY HAS BEEN COMPLETED
Z
7000
REWIND INPUT TAPE
REWIND OUTPUT TAPE
RETURN TO CALLING PROGRAM


SUBROUTINE READ1
SET ERROR FLAG TO ZERO
10
READ INPUT RECORD
INPUT TAPE
"FUELS" TOTALS FROM STRIPPED NEDS FILES AREA SOURCE CATEGORY EPA (DUR)219,3/72
HAS AN END-OF FILE BEEN ENCOUNTERED ?
YES
A
NO
IS THIS THE COUNTY OF INTEREST ?
YES
REWIND INPUT TAPE
NO
B
A
7000
ERROR ENCOUNTERED SET ERROR FLAG TO 1.
PRINT ERROR MESSAGE THAT EOF ENCOUNTERED BEFORE CORRECT COUNTY FOUND (CARDS OUT OF ORDER OR JCL ERROR)
B
RETURN TO CALLING PROGRAM

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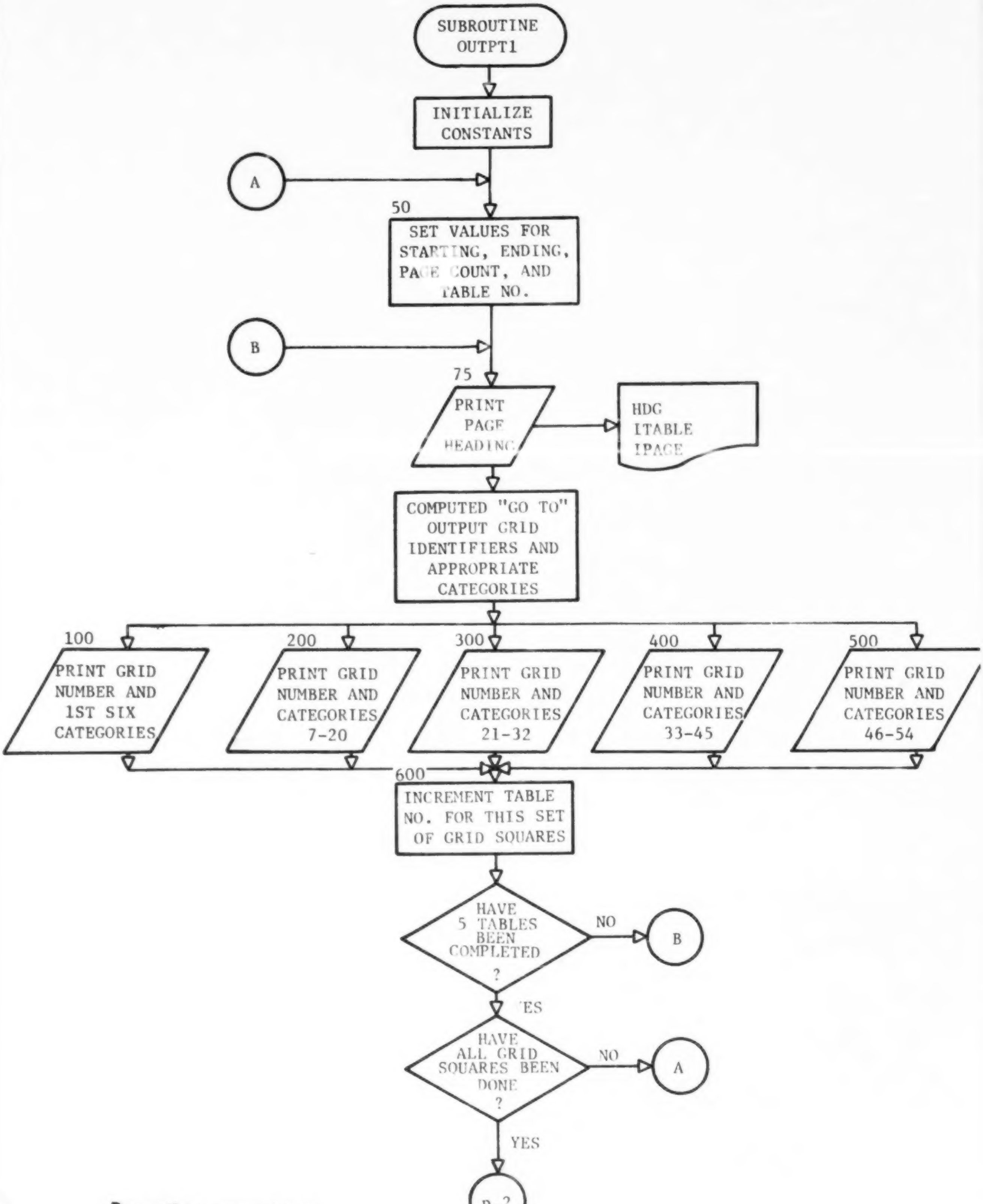
SUBROUTINE OUTPT1
INITIALIZE CONSTANTS
A
50
SET VALUES FOR STARTING, ENDING, PAGE COUNT, AND TABLE NO.
B
75
PRINT PAGE HEADING
HDG
ITABLE
IPAGE
COMPUTED "GO TO" OUTPUT GRID IDENTIFIERS AND APPROPRIATE CATEGORIES
100
PRINT GRID NUMBER AND 1ST SIX CATEGORIES
200
PRINT GRID NUMBER AND CATEGORIES 7-20
300
PRINT GRID NUMBER AND CATEGORIES 21-32
400
PRINT GRID NUMBER AND CATEGORIES 33-45
500
PRINT GRID NUMBER AND CATEGORIES 46-54
600
INCREMENT TABLE NO. FOR THIS SET OF GRID SQUARES
HAVE 5 TABLES BEEN COMPLETED ?
NO
B
YES
HAVE ALL GRID SQUARES BEEN DONE ?
NO
A
YES
p.2

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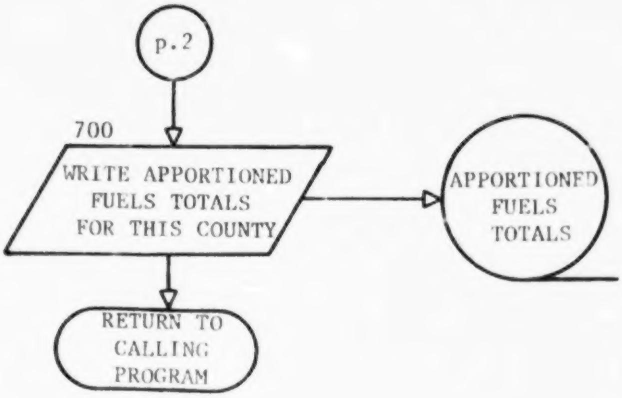
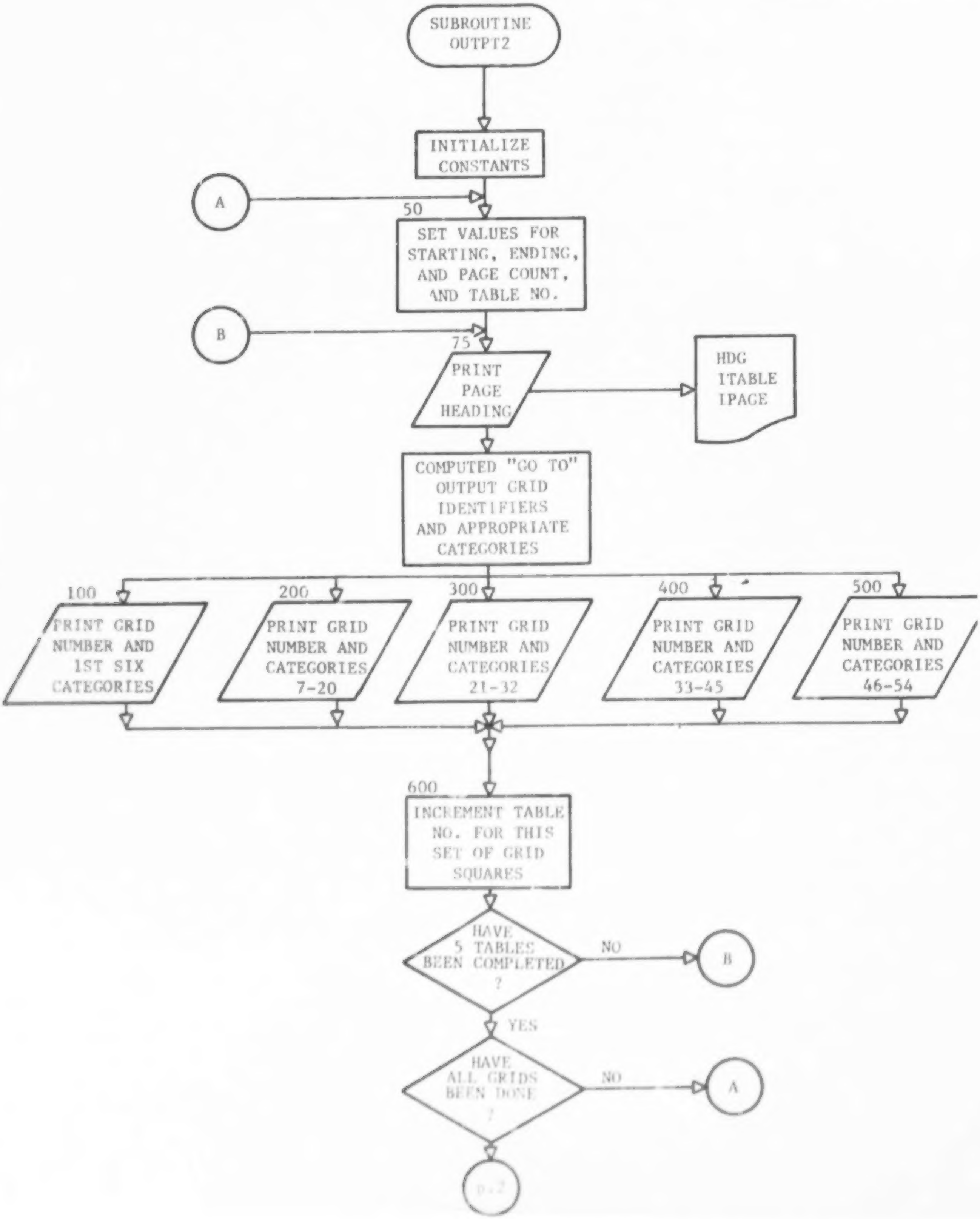
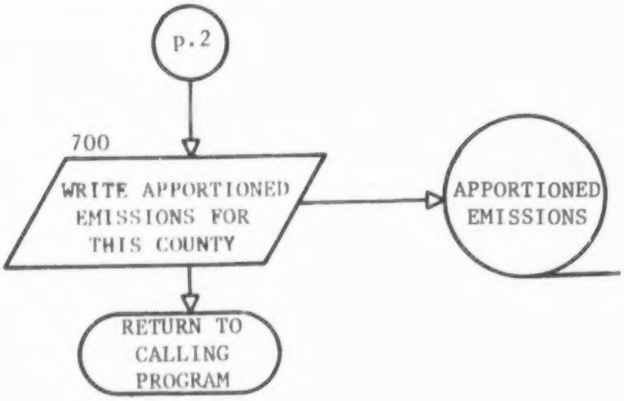
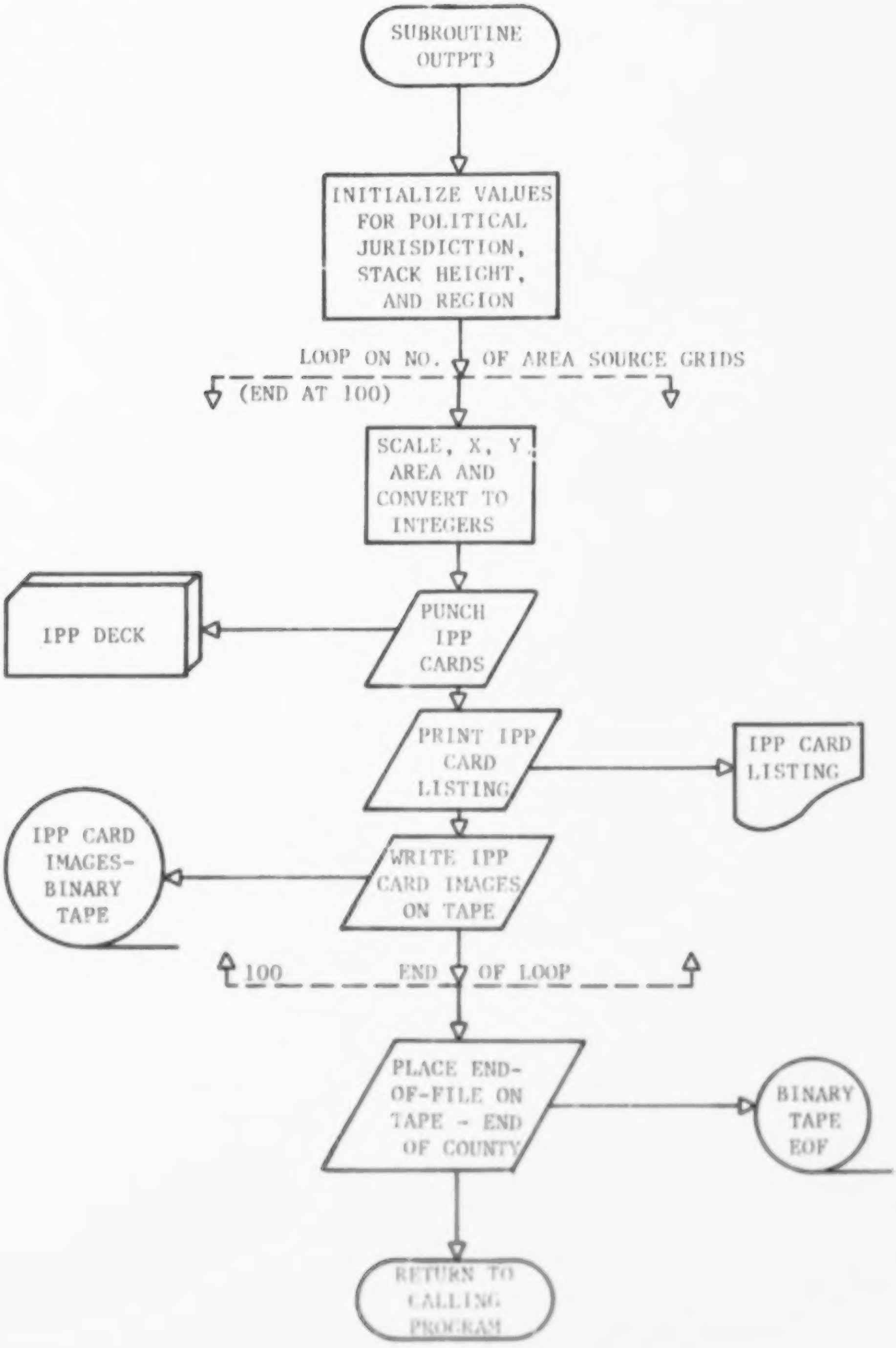

p.2
700
WRITE APPORTIONED FUELS TOTALS FOR THIS COUNTY
APPORTIONED FUELS TOTALS
RETURN TO CALLING PROGRAM


SUBROUTINE OUTPT2
INITIALIZE CONSTANTS
A
50
SET VALUES FOR STARTING, ENDING, AND PAGE COUNT, AND TABLE NO.
B
75
PRINT PAGE HEADING
HDG ITABLE IPAGE
COMPUTED "GO TO" OUTPUT GRID IDENTIFIERS AND APPROPRIATE CATEGORIES
100
PRINT GRID NUMBER AND 1ST SIX CATEGORIES
200
PRINT GRID NUMBER AND CATEGORIES 7-20
300
PRINT GRID NUMBER AND CATEGORIES 21-32
400
PRINT GRID NUMBER AND CATEGORIES 33-45
500
PRINT GRID NUMBER AND CATEGORIES 46-54
600
INCREMENT TABLE NO. FOR THIS SET OF GRID SQUARES
HAVE 5 TABLES BEEN COMPLETED ?
NO
B
YES
HAVE ALL GRIDS BEEN DONE ?
NO
A
p.2


p.2
700
WRITE APPORTIONED EMISSIONS FOR THIS COUNTY
APPORTIONED EMISSIONS
RETURN TO CALLING PROGRAM


SUBROUTINE OUTPT3
INITIALIZE VALUES FOR POLITICAL JURISDICTION, STACK HEIGHT, AND REGION
LOOP ON NO. OF AREA SOURCE GRIDS
(END AT 100)
SCALE, X, Y, AREA AND CONVERT TO INTEGERS
PUNCH IPP CARDS
IPP DECK
PRINT IPP CARD LISTING
IPP CARD LISTING
WRITE IPP CARD IMAGES ON TAPE
IPP CARD IMAGES-BINARY TAPE
100
END OF LOOP
PLACE END-OF-FILE ON TAPE - END OF COUNTY
BINARY TAPE EOF
RETURN TO CALLING PROGRAM